HOWARD W. SAMS & COMPANY CP34 09015

COMPUTERFACTS™

Technical Service Data

OKIDATA®

OKIMATE 20 (MODEL EN3211)

PRINTER

FEATURES COMPLETE SCHEMATICS • PRELIMINARY SERVICE CHECKS • TROUBLESHOOTING TIPS • EASY-READ WAVEFORMS • REPLACEMENT PARTS LISTS • SEMICONDUCTOR CROSS-REFERENCE

PRELIMINARY SERVICE CHECKS

This data provides the user with a time-saving service tool which is designed for quick isolation and repair of Computer system malfunctions.

Check all interconnecting cables for good connection and correct hook-up before making service checks.

Always turn Printer Off before connecting or disconnecting connectors, boards or Computer.

Replacement or repair of the Power Supply, Driver Board, Interface Board or connectors may be necessary after the malfunction has been isolated.

TEST EQUIPMENT

Digital Volt/Ohm Meter
Resistor, 390 Ohms, 1/2W
Resistor, 30 Ohms, 10W

TOOLS

Head Cleaning Equipment (Ethyl Alcohol)
Contact and Switch Cleaner (non-spray type)
Phillips Screwdriver
Flat-Blade Screwdriver
IC Insertion and Removal Tools 28 pin
Low Wattage Soldering Iron
Desoldering Equipment

REPLACEMENT PARTS AND DESCRIPTION

F	Fuse 2A
Q1	Transistor (Power Supply Board)
SI1	Bridge Rectifier
SW	On-Off Switch
L1	Coil
R1	Resistor, 5.1 Ohms 3W
M7	Print Head
Q1	ROM IC
M1	Line Feed Motor
M5	Home Position Sensor
M2	Carriage Motor
SW3	Ribbon End Switch
M4	Paper End Sensor

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The listing of any available replacement part herein does not constitute in any case a recommendation, warranty or guaranty by Howard W. Sams & Co. as to the quality and suitability of such replacement part. The numbers of these parts have been compiled from information furnished to Howard W. Sams & Co. by the manufacturers of the particular type of replacement part listed.

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PRELIMINARY SERVICE CHECKS (Continued)

DISASSEMBLY INSTRUCTIONS

CABINET REMOVAL

Remove ribbon cartridge and carriage assembly cover. Remove two screws located in front of Carriage assembly holding cabinet top to chassis. Push cabinet top toward rear to release tabs on inside rear edge and lift up rear. When rear edge is clear of chassis, move top forward to clear front tabs and lift top from Printer.

PRINTER MECHANISM REMOVAL

Remove Control Panel cover. Disconnect Connectors CN4 thru CN8.

NOTE: Lift up cap on Connector CN6 before pulling flat ribbon cable out.

Remove three screws holding mechanism to cabinet bottom.

POWER SUPPLY AND DRIVER BOARD REMOVAL

Remove cabinet top and Printer mechanism. Remove two screws holding Power Supply Board to cabinet bottom. Push back tabs holding front of Driver Board and lift Driver and Power Supply Boards from cabinet.

CARRIAGE MOTOR ASSEMBLY REMOVAL

Remove cabinet top. Disconnect Connector CN6 from Driver Board. Remove two screws holding motor assembly and remove assembly.

PAPER FEED MOTOR REMOVAL

Remove Printer mechanism. Disconnect Connector CN8 from Driver Board. Remove two screws holding Paper Feed Motor and remove Motor.

BELT REMOVAL

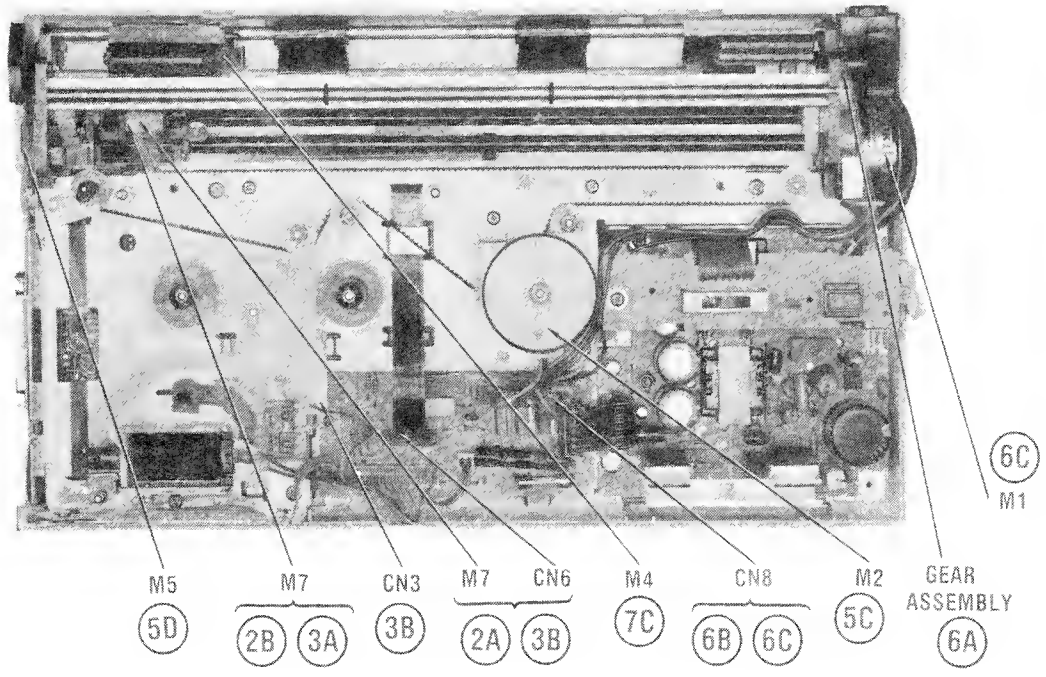
Remove cabinet top and Control Panel cover. Remove Carriage Motor assembly. Remove two springs from metal linkage going from Head Hold Solenoid to left belt gear (one spring at each end of the link). Insert a flat-blade screwdriver between left belt gear and metal link. Pry link and ribbon stop lever off gear post, note position of ribbon stop lever for reassembly. Remove belt from Print Head assembly and gear pulleys.

RIBBON REMOVAL

Turn Power Off. Lift ribbon access cover. Pull back on Print Head assembly until it snaps back. Lift used ribbon cartridge out. Place new cartridge into compartment, rear end first. While lowering front end, make sure ribbon is in front of Print Head and behind ribbon guides. Snap head back into printing position.

REPLACING PRINT HEAD

Remove ribbon cartridge. Pull back on Print Head Lock Lever, directly behind Print Head. Lift Print Head straight up out of holder.



CHASSIS-OVERALL VIEW

PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS

MATCH THE NUMBERS ON THE INTERCONNECTING DIAGRAM AND PHOTOS WITH THE NUMBERS ON THE SERVICE CHECKS TO BE PERFORMED.

PRINTER DEAD

(1) (A) Check Fuse F on Power Supply Board. If open, check for possible shorts at Diode Si1 and Oscillator Transistor (Q1).

(B) If Fuse F is good, apply power and check for 167V at the cathode of Diode Si1. If 167V is missing, check On-Off Switch (SW), Coil L1, Resistor R1 and Diode Si1.

(C) If 167V is present at Diode Si1, check for 14.4V at pin 1 of Connector CN9 on Driver Board. If reading is not correct, check adjustment of Voltage Adjust Control (VR).

(D) If 14.4V is missing at pin 1 of Connector CN9, turn Power Off, disconnect Connector CN9 and connect a 390 Ohms resistor from pin 3 to pin 4 and a 30 Ohms 10W load from pin 1 to pin 6 of Connector CN on Power Supply. Apply power and recheck Power Supply output voltages. If voltages are still missing, troubleshoot Power Supply Board. If voltages return, troubleshoot Driver and Interface Boards.

(2) PRINT HEAD WILL NOT PRINT

(A) Check Print Head (M7) connections and Connector CN6. Check Print Head Ribbon Cable.

(B) Examine element points on Print Head. If elements appear dirty, clean Head with a soft cloth dampened with ethyl alcohol. If elements appear white, substitute Print Head.

(3) MISSING DOTS IN THE PRINT PATTERN

(A) Clean Print Head face with a soft cloth dampened with ethyl alcohol.

(B) Check Print Head connections and Connectors CN3 and CN6.

(4) PRINTER WILL NOT PRINT BY COMPUTER COMMAND

(A) Check Connector CN2 on Interface Board.

(B) Check settings of DIP Switches SW1 and SW2 on Interface Board. See "Switch Settings" for a list of the various settings.

(C) Check ROM IC (Q1) by substitution.

(5) PRINTER CARRIAGE ASSEMBLY

(A) Carriage asembly does not move. Check carriage assembly belt, gears and pulleys.

(B) Check Connectors CN3, CN5, CN7 and CN9.

(C) Check Carriage Motor (M2) windings for continuity. Check for 14 Ohms from pin 1 to pin 5, pin 3 to pin 5, pin 2 to pin 6 and pin 4 to pin 6 of Connector CN7.

(D) Carriage assembly moves to right only and stops. Check operation of Home Position Sensor. Check for 4.5V at pin 8 of Connector CN5 when Print Head is at Home Position and 0V when Head is not at Home Postion. If readings are not correct, check pins 6, 7 and 8 of Connector CN5 and the Home Position Sensor (M5).

(6) LINE FEED WILL NOT OPERATE

(A) Check Line Feed gear assembly on right side of platen.

(B) Check Connector CN8.

(C) Check windings of Line Feed Motor (M1) for continuity. Check for 7 Ohms from pin 1 to pin 5, pin 3 to pin 5, pin 2 to pin 6 and pin 4 to pin 6 of Connector CN8.

(7) READY LED BLINKS

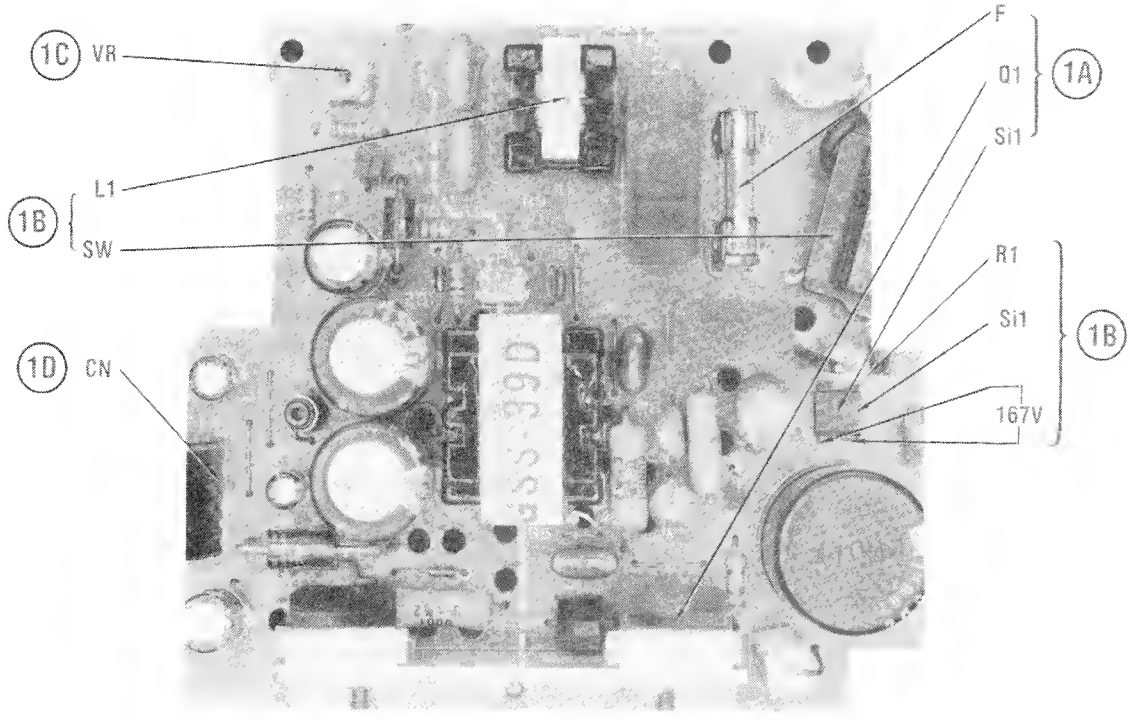
(A) Ready LED blinks, pressing Select Switch has no effect. Check pins 1 thru 5 of Connector CN5.

(B) Turn Printer Off. Check operation of Ribbon End Switch (SW3) with an ohmmeter at pins 1 and 2 of Connector CN5. The reading should be zero ohms with Switch activated and infinity with Switch not activated.

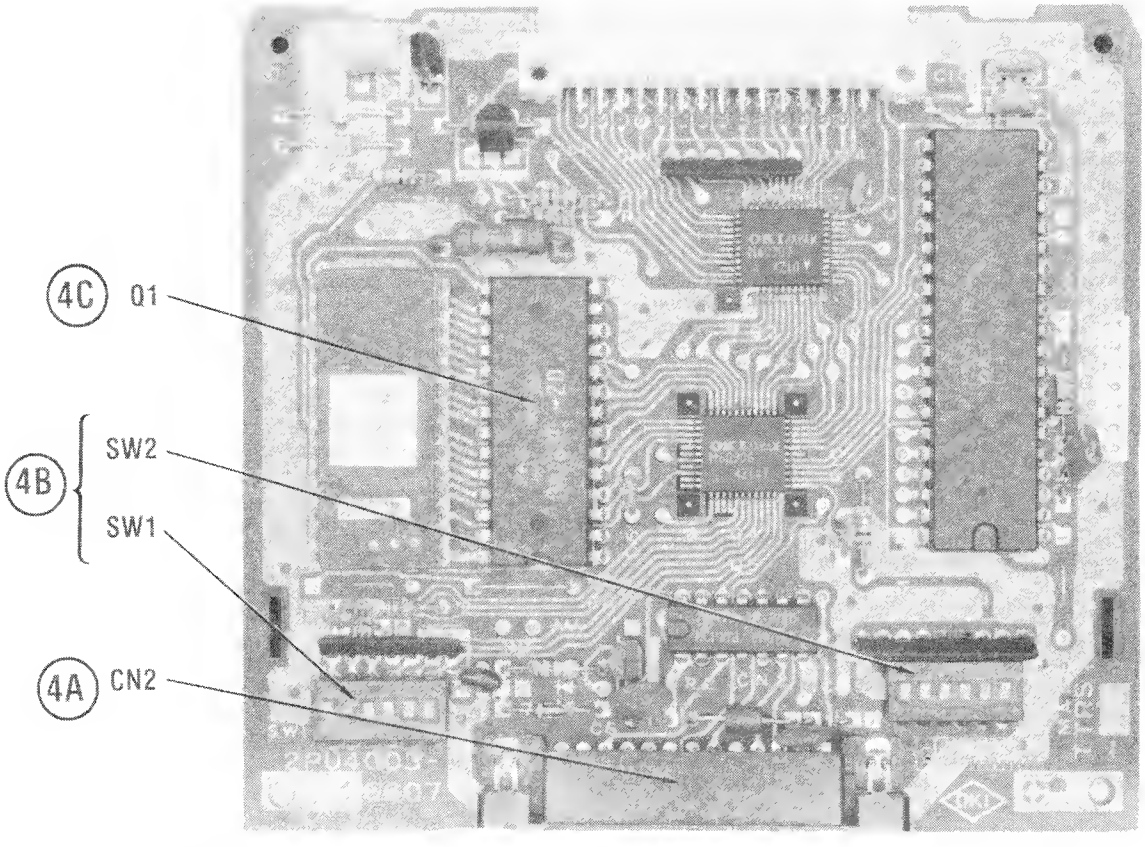
(C) Turn Printer On and check operation of the Paper End Sensor (M4). Check for 5.0V at pin 1 of Connector CN5 with paper in Printer and 0V with no paper.

NOTE: The Ribbon End Switch must not be activated.

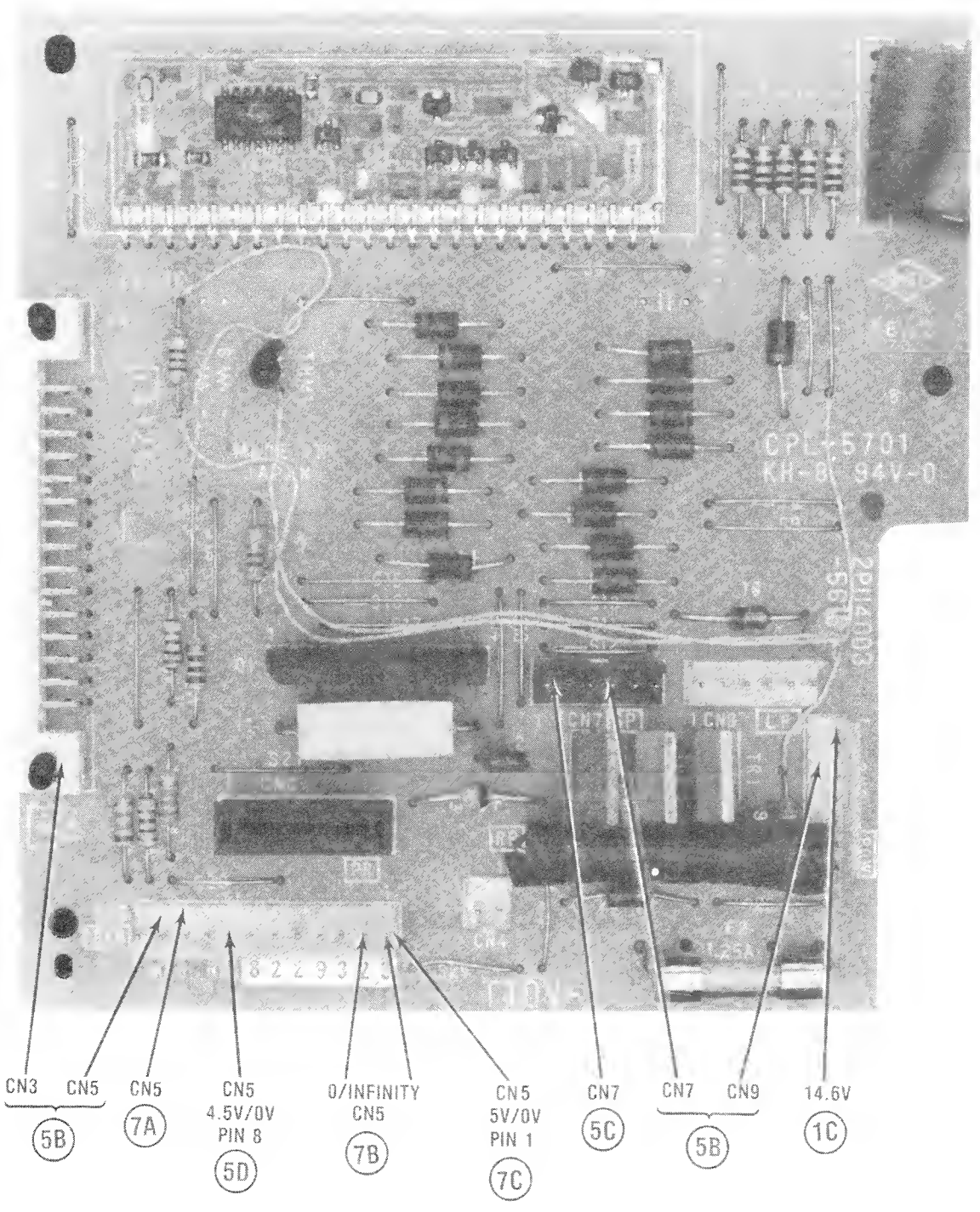
If readings are not correct, check Paper End Sensor (M4).



POWER SUPPLY BOARD



INTERFACE BOARD


CN3
CN5
5B
CN5
7A
CN5
4.5V/0V
PIN 8
5D
0/INFINITY
CN5
7B
CN5
5V/0V
PIN 1
7C
CN7
5C
CN7
CN9
5B
14.6V
1C

PRELIMINARY SERVICE CHECKS (Continued)

GENERAL OPERATING INSTRUCTIONS

SELF-TEST

Self-Test continuously prints the character set. To start test, hold Select button down while turning Printer On. Continue to hold Select button for two seconds, then release it. To stop test, press Select button.

NOTE: Do not use a colored ribbon when running Self-Test.

DARKNESS BUTTON

Slide Darkness button to left to print lighter, to right to print darker.

SELECT BUTTON

Press Select button once to pause, ready LED will start blinking. To Form Feed, pause Printer, press and hold Select button for two seconds.

SWITCH SETTINGS

Serial Interface Board Switches

SWITCH SW1	ON	OFF
300 Baud		1,2
1200 Baud	1	2
4800 Baud	2	1
9600 Baud	1,2	
7 Bit with parity	3,4	
8 Bit with parity	3	4
8 Bit without parity		3,4
Even parity	5	
Odd parity		5
X-ON/X-OFF Protocol		6
Ready/Busy Protocol	6	
Space at printer ready (Ready=High, +)	5	
Mark at printer ready (Ready=Low, -)		5

SWITCH SW2	ON	OFF
Spanish Characters	1	
ASCII Characters		1
17.1 CPI (Characters per inch)	2	
10 CPI		2
Auto LF (linefeed) On	3	
Auto LF Off		3
IBM Character Set #1		4
IBM Character Set #2	4	
Draft Quality	6	
Correspondence Quality		6

MISCELLANEOUS ADJUSTMENTS

POWER SUPPLY VOLTAGE ADJUSTMENT

Connect input of a DC voltmeter to pin 1 of Connector CN9 on Driver Board. Adjust Voltage Adjust Control (VR) for 14.4V.

PRINT HEAD CLEARANCE

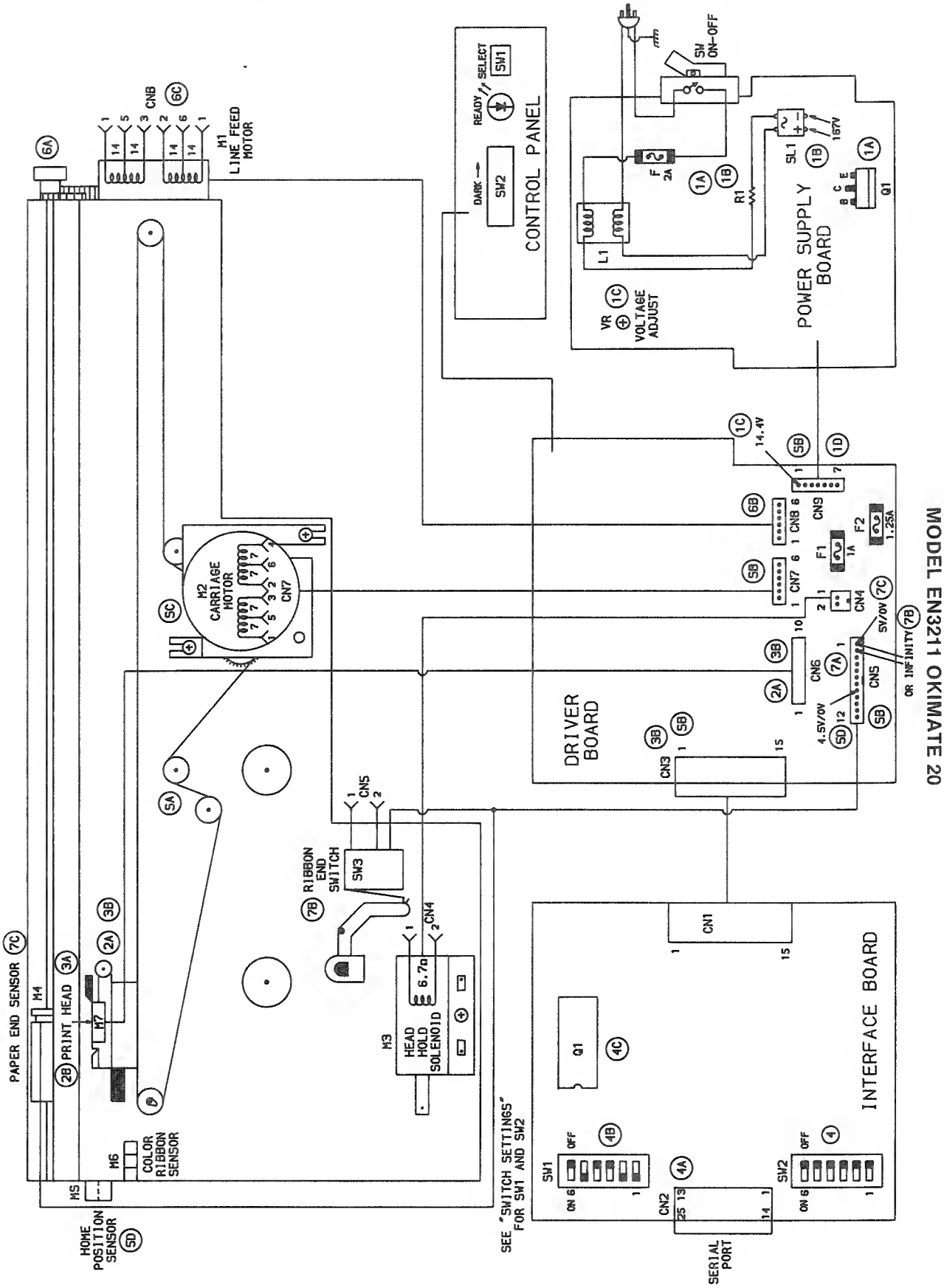
Remove cabinet top. Loosen Phillips screw holding Head Hold Solenoid to Printer chassis. Move Solenoid to align metal slide-bar index marker with index marker on plastic end piece.

NOTE: Head Hold Solenoid is not activated while making this adjustment.

Clearance between ribbon guide and platen and between ribbon guide and ribbon stop rubber should be .02 to .04 inch (5 to 1mm). Tighten Solenoid mounting screw.

BELT TENSION

Remove cabinet top. Loosen two screws holding Carriage Motor. Measure tension of belt by hooking a tension guage in hole located on left front of the Carriage Motor. Pull guage until a tension of .66 ± .066 pounds (300 ± 30 grams) is reached and tighten Motor mount screws.



INTERCONNECTING DIAGRAM

PRELIMINARY SERVICE CHECKS (Continued)
PREVENTATIVE MAINTENANCE

ENVIRONMENT

Computers perform best in a clean, cool area that is below 80 degrees Fahrenheit and free of dust and smoke particles. Even though home Computers are not affected by cigarette smoke as much as commercial Computers are affected, it is better to maintain a smoke-free area around the Computer. Do not block cabinet vents of Computer, Monitor, Printer, or other power devices.

ELECTRICAL POWER

Variations in the line voltage can affect the Computer. Try to avoid these fluctuations by using an AC receptacle that is on a power line not used by appliances or other heavy current demand devices. A power-surge protector, power-line conditioner, or non-interruptable power supply may be needed to cure the problem. **Do not** switch power On and Off frequently.

KEYBOARD

Liquids spilled into the Keyboard can ruin it. Immediately after a spill occurs, disconnect the Computer power plug from AC power outlet. Then, if circuitry or contacts are contaminated, disassemble the Keyboard and carefully rinse the Keyboard printed circuit board with distilled water and let it dry. Use a cotton swab to clean between the keys. Use a non-abrasive contact cleaner and lint-free wipers on accessible connectors and contacts.

DISK DRIVES

Clean the read/write heads of the Disk Drives about once a month or after 100 hours usage. Use only an approved head cleaning kit.

Handle carefully to preserve proper disk head alignment. A sudden bump or jolt to the Disk Drives can knock the disk head out of alignment. If Disk Drive must be transported, place an old disk in slot and close door during transport.

Store disks in their protective covers and never touch the disk surface. Observe the disk handling precautions usually found on the back of disk protective covers.

PRINTERS

Carefully vacuum the Printer regularly. Wipe surface areas clean using a light all-purpose cleaner. Do not oil the machine. The oil will collect abrasive grit and dust. The dust will act as a blanket. This can cause components to overheat and fail.

STATIC ELECTRICITY

Static electricity discharge can affect the Computer. In order to minimize the possibility, use anti-static mats, sprays, tools and materials, and maintain good humidity in the Computer environment.

MONITOR

Use an isolation transformer with any Monitor that does not come as part of the system since some Monitors use a HOT chassis (chassis connected to one side of the AC line). The face of the Monitor should never be left on for long period of time at high brightness level except when pattern is being changed periodically. Use caution when cleaning anti-glare screens, to preserve the glare-reduction feature.

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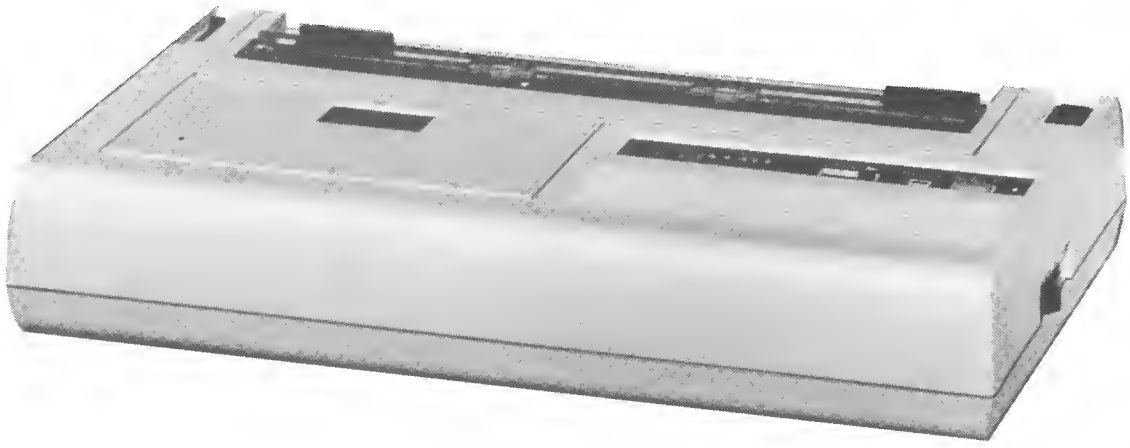
CP34



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MODEL EN3211 OKIMATE 20

SAFETY PRECAUTIONS

See Page 29

INDEX

	Page
Block Diagram	28
Disassembly Instructions	27
General Operating Instructions	18
GridTrace Location Guide	
Interface Board	22
Power Supply Board	20
IC Pinouts and Terminal Guides	8
Line Definitions	11
Logic Chart	17
Miscellaneous Adjustments	18
Parts List	12 thru 16

	Page
Photos	
Chassis-Overall View	24
Driver Board	4,25
Interface Board	22,23
Power Supply Board	20,21
Safety Precautions	29
Schematics	2,3,5,6,7,26
Schematic Notes	19
Test Equipment	9
Troubleshooting	9,10,11

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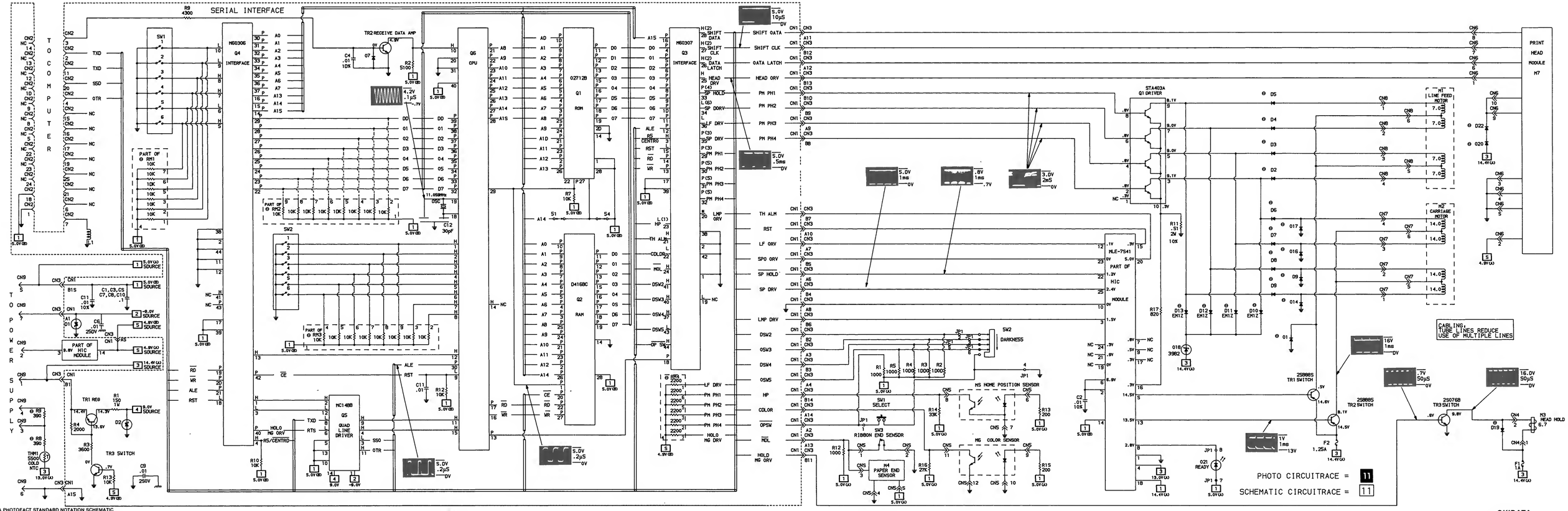

A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE

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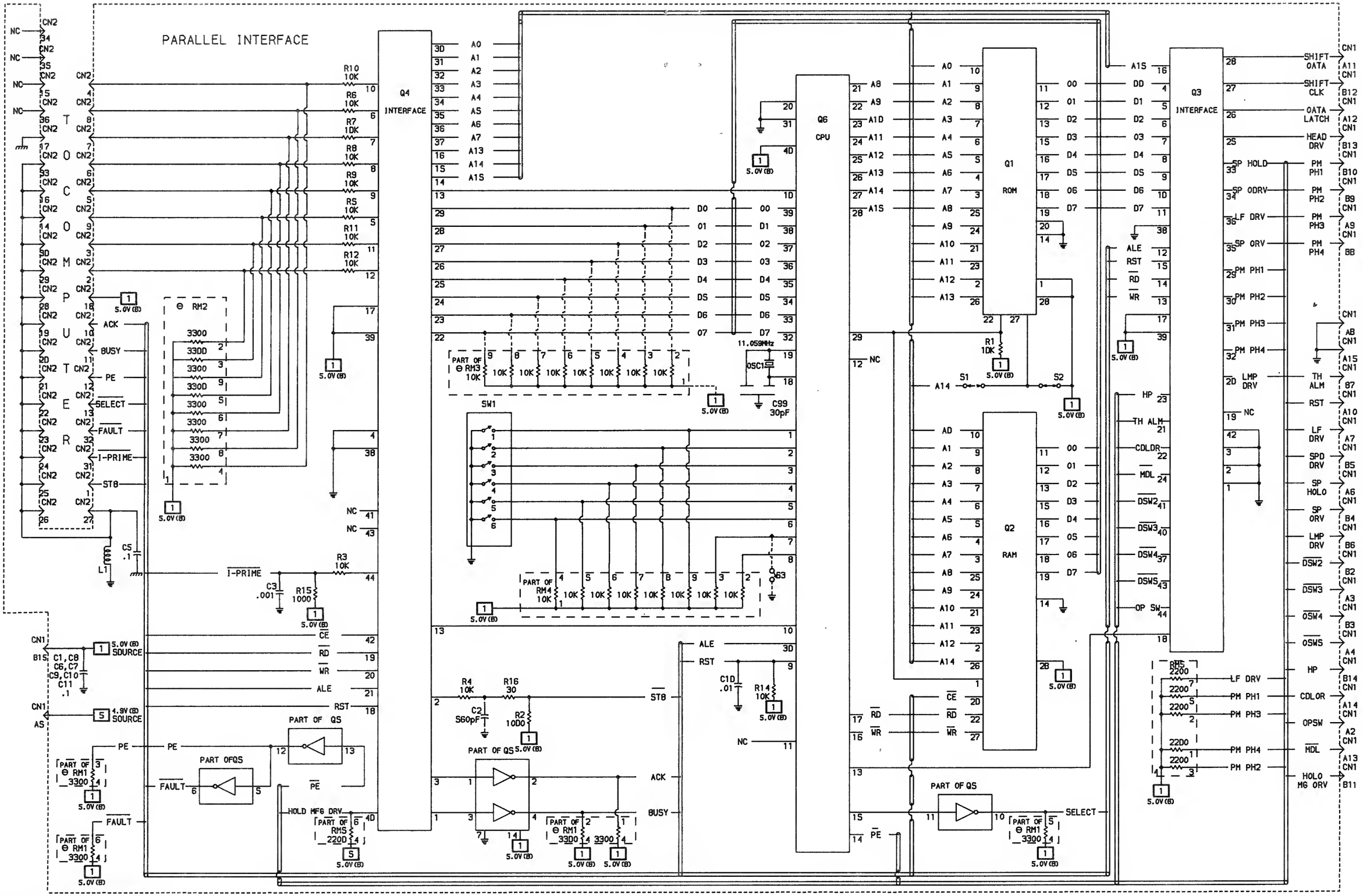

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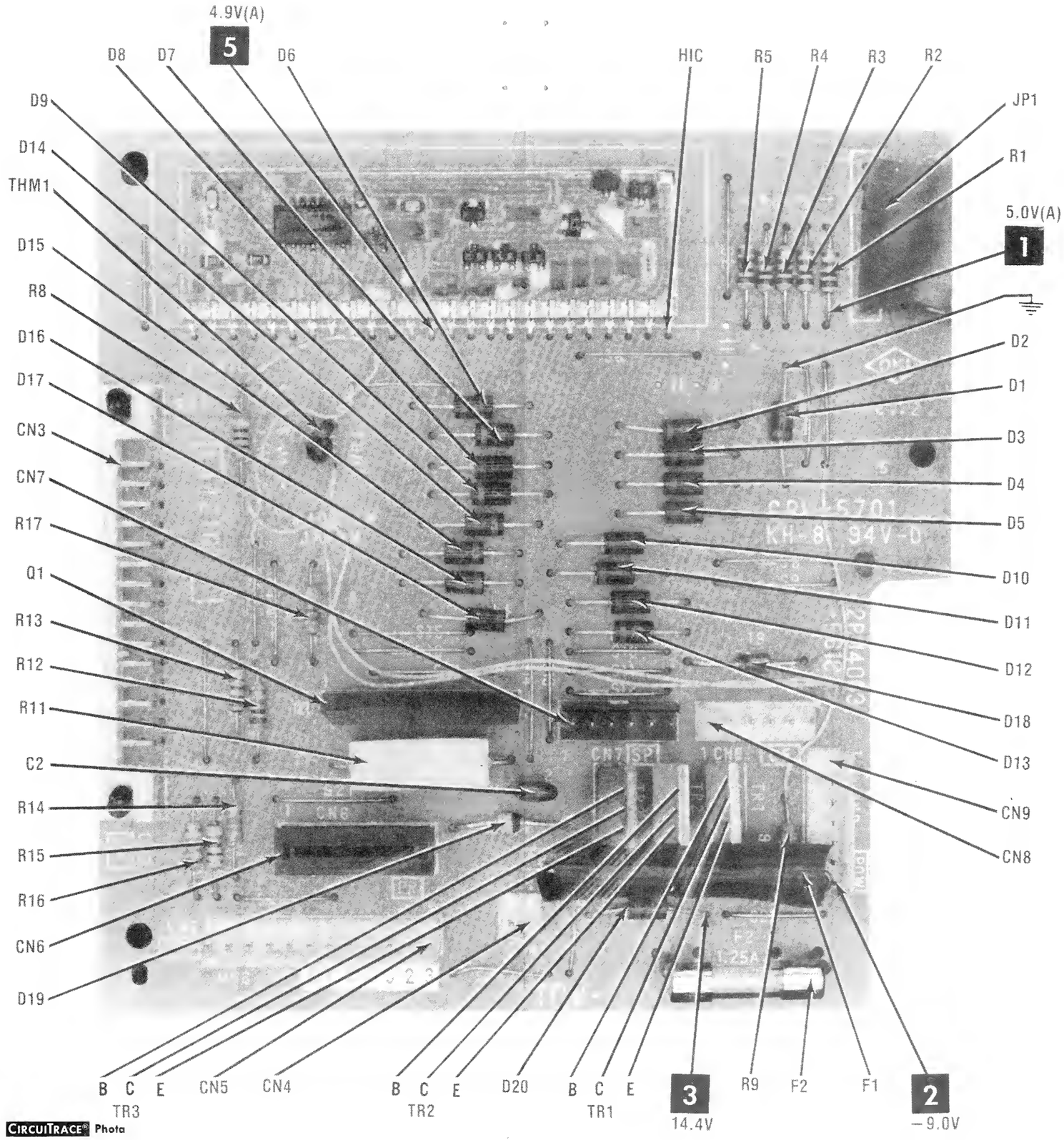

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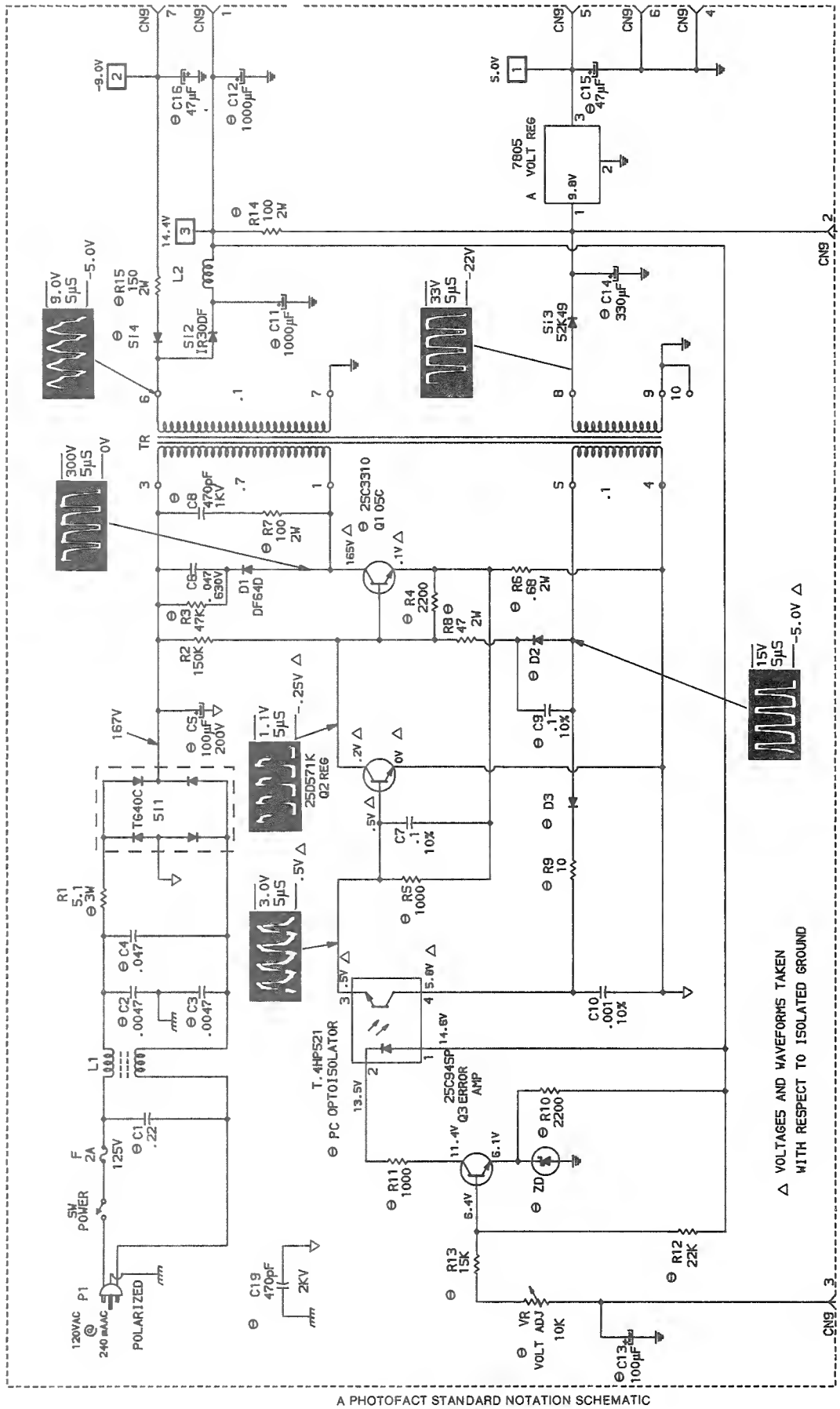

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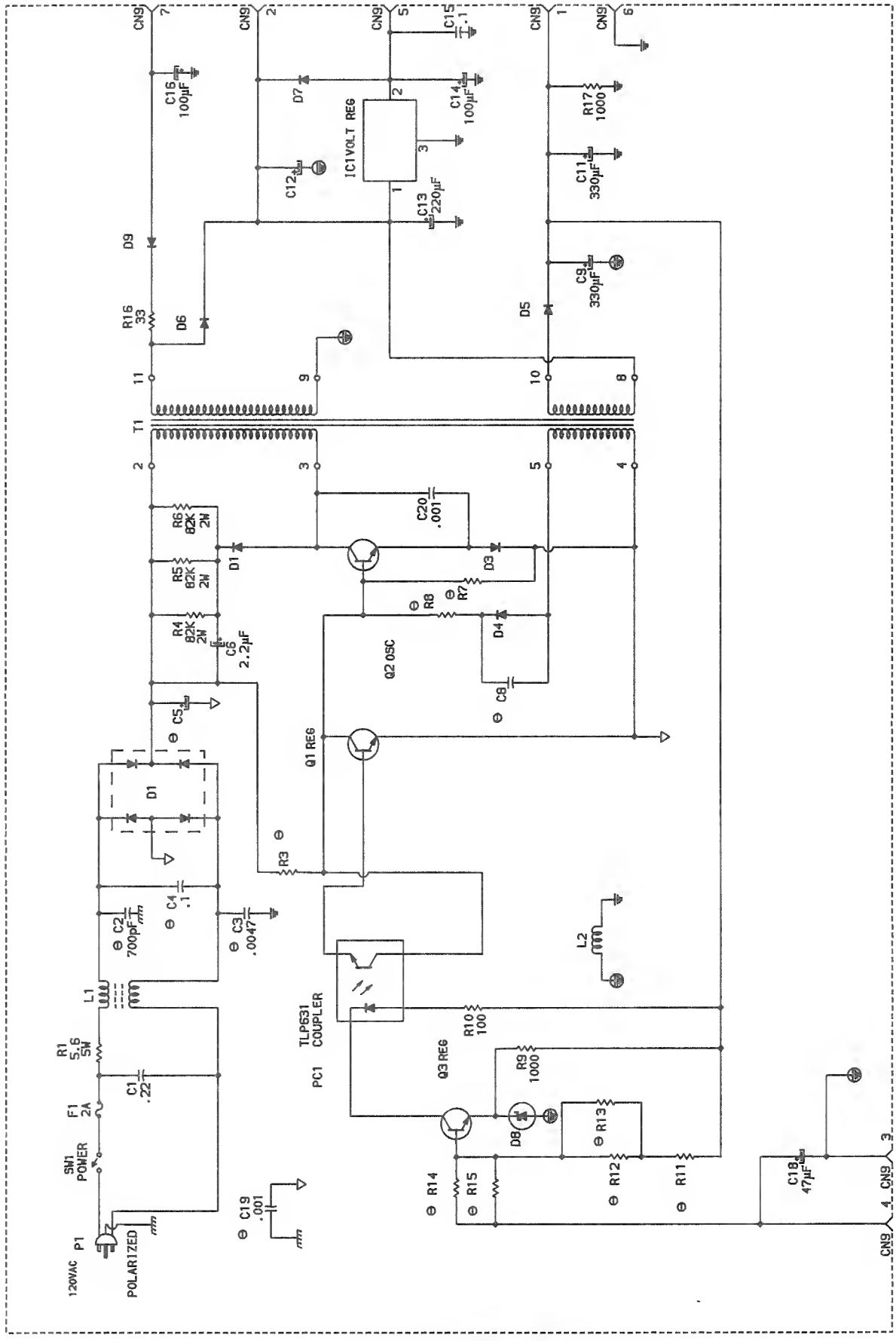

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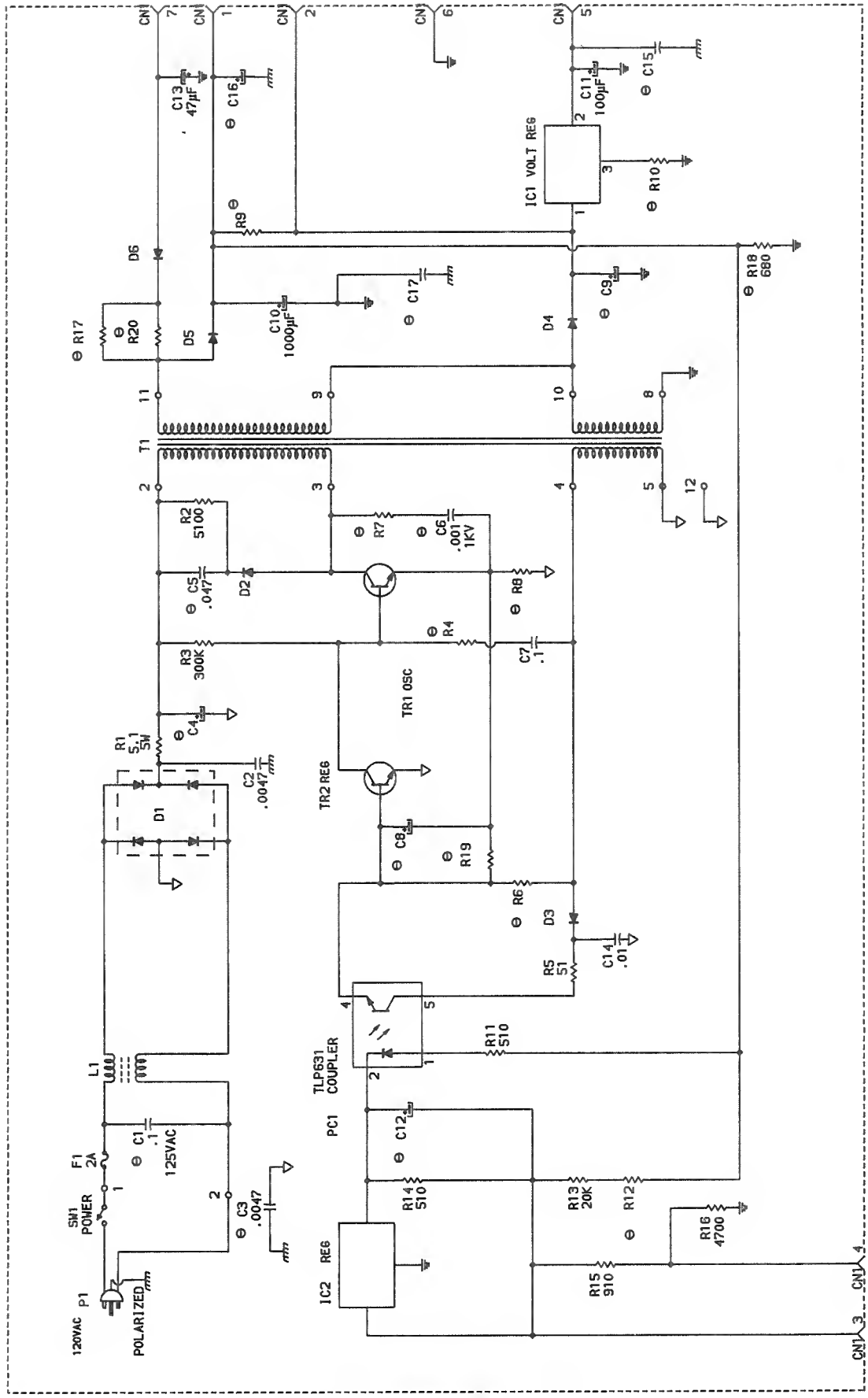
ALTERNATE POWER SUPPLY



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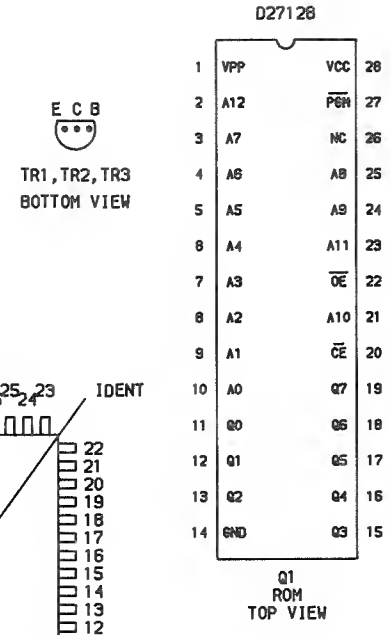
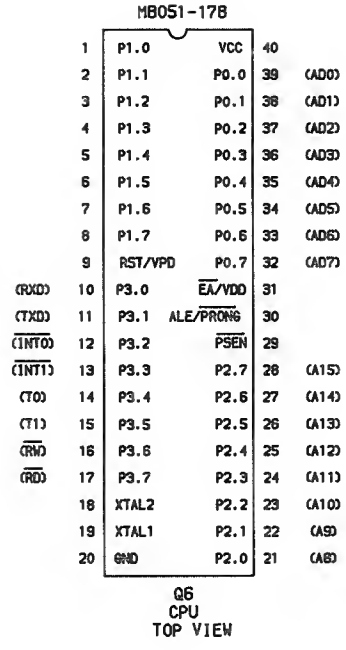
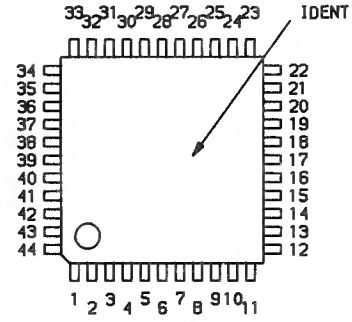
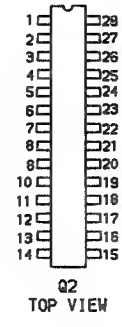
ALTERNATE POWER SUPPLY

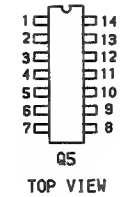
IC PINOUTS & TERMINAL GUIDES



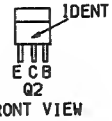


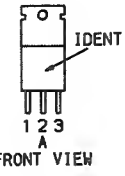


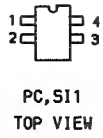


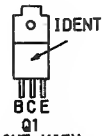


POWER SUPPLY

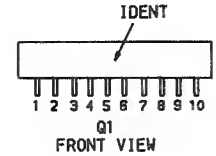


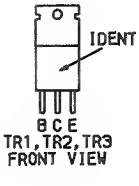






DRIVER BOARD





TEST EQUIPMENT

Test Equipment listed by Manufacturer illustrates typical or equivalent equipment used by SAMS' Engineers to obtain measurements and is compatible with most types used by field service technicians.

TEST EQUIPMENT (COMPUTERFACTS)

Equipment	B & K Precision Equipment No.	Sencore Equipment No.	Notes
OSCILLOSCOPE	1570A,1590A,1596	SC61	
LOGIC PROBE	DP51,DP21		
LOGIC PULSER	DP101,DP31		
DIGITAL VOM	2830,2806	DVM37,DVM56,SC61	
ANALOG VOM	277,111,116		
ISOLATION TRANSFORMER	TR110,1604,1653,1655	PR57	
FREQUENCY COUNTER	1803,1805	FC71,SC61	
COLOR BAR GENERATOR	1211A,1251,1260,1249	CG25,VA62	
RGB GENERATOR	1260,1249		
FUNCTION GENERATOR	3020,3011,3030		
HI-VOLTAGE PROBE VOM/DMM Accessory probes	HV-44 PR-28(HV)	HP200	
TEMPERATURE PROBE	TP-28,TP-30		
CRT ANALYZER	467,470	CR70	
DIGITAL IC TESTER	560,550,552		
CAPACITANCE ANALYZER		LC53,LC75,LC76 LC77	
INDUCTANCE ANALYZER		LC53,LC75,LC76 LC77	

TROUBLESHOOTING

POWER SUPPLY

NOTE: Use an isolation transformer with a step down control when servicing power supply.

Disconnect Connector CN9 from Driver Board to avoid possible damage to Printer from high voltage that may be produced while servicing Power Supply.

NOTE: Power Supply will not operate properly if Connector CN9 is disconnected from Driver Board unless the proper bias and load Resistors are connected to Connector CN9.

Connect a 390 ohms 1/2W bias Resistor from pin 3 to pin 4 and 4700 ohms 1/2W bias Resistor from pin 3 to pin 5 of Connector CN9. Also connect a 30 ohms, 10W load Resistor from pin 1 to pin 6 and a 10 ohms, 10W load Resistor from pin 5 to pin 6 of Connector CN9.

POWER SUPPLY DEAD

Check Fuse F. If fuse is open, check for possible shorts at Bridge Rectifier Si1 and Oscillator Transistor (Q1). If fuse is good, apply AC power and check for 120V AC at the AC input pins of Si1. If 120V AC is missing, check Resistor R1, Coil L1 and Switch SW. If 120V AC is present, check for 167V at the cathode of Si1. If 167V is missing, check Si1. If 167V is present, check waveform at base of Oscillator Transistor (Q1). If waveform is missing, check voltages and components associated with Q1 and Regulator Transistor (Q2) and check Transformer TR.

The 14.4V Source is missing. Check Coil L2, Diode Si2, Capacitor C11 and check the winding on Transformer TR from pin 6 to pin 7 for continuity.

The 14.6V source is not correct and adjusting voltage Adjust Control VR has no affect. Check voltage and components associated with Error Amp Transistor (Q3) and Optoisolator (PC).

Regulated 5.0V source is not correct or missing. Check 5V Regulator IC (A), Diode Si3, Capacitors C14 and C15 and check winding on Transformer TR from pin 8 to pin 9 for continuity.

The -9.0V source is missing at pin 7 of Connector CN9 on Driver Board. Check Diode Si4, Capacitor C16 and Resistor R15 on Power Supply Board and Zener Diode D1 and Capacitor C6 on Interface Board.

The 9.0V source is missing on the Interface Board (cathode of Zener Diode D2). Check Zener Diode D2 and the voltages and components associated with Regulator Transistor (TR1) and Switch Transistor (TR3) on Interface Board.

CPU OPERATION

Check for a 11.059MHz waveform at pin 19 of CPU IC (Q6) on the Interface Board. If waveform is missing or frequency not correct, check Crystal X1, Capacitor C12 and IC Q6. Check Reset logic at pin 9 of IC Q6 while turning Printer On. The logic should be High then immediately go Low and stay Low. If logic is not correct, check Capacitors C11 and C2, Resistor R12, IC Q6 and Module HIC.

PRINT HEAD

Print Head not printing or dots are missing (Head Hold Solenoid works). Examine element points on Print Head. If element points appear dirty, clean Head with a soft cloth dampened with ethyl alcohol. If element points appear white, Print Head may be bad. Substitute Print Head and check Printer operation. If Print Head is good, check Print Head contacts, pins 1 thru 10 of Connector CN6 on Driver Board and pins A11, A12, B12 and B13 of Connector CN3 on Driver Board and CN1 on Interface Board for good connections. If connections are good, check for 14.2V at pin 10 of Connector CN6. If 14.2V is missing, check Diode D20. If 14.2V is present, check Interface IC (Q3) on the Interface Board.

PRINT HEAD HOLD SOLENOID DOES NOT WORK

Check Fuse F1 on the Driver Board. If Fuse is open, check for a possible shorted Head Hold Solenoid (M3), Diode D19 or Solenoid Switch Transistor (TR3). If Fuse is good, check Connector CN4 and pin B11 of Connector CN3 for good connections and check Solenoid M3 winding for continuity (6.7 ohms). If Connectors and Solenoid are good, run Printer in Self-Test mode and check waveform at the base of Transistor TR3. If waveform is missing, check Interface IC (Q4) on the Interface Board. If waveform is present, check Transistor TR3 and Diode D19.

CARRIAGE MOTOR

Carriage assembly moves to right and stops or moves to left and bangs against left stop. Check operation of Home Position Sensor (M5), refer to the "Sensor" section of this Troubleshooting guide.

Carriage assembly does not move. Check belt, pulleys and carriage mechanism for smooth operation with no binding. If no problem is found, check Fuse F2 on Driver Board. If Fuse is open, check Switch Transistors (TR1 and TR2), Diode D1 and Driver Transistor Array (Q1) for possible shorts. If Fuse F2 is good, turn Printer On and check for 14.4V at pin 1 of Connector CN9 on Driver Board. If 14.4V is missing, refer to the "Power Supply" section of this Troubleshooting guide. If 14.4V is present, check waveforms at pins B4, B8, B9, B10, A6 and A9 of Connector CN3 on Driver Board. If waveforms are missing, check Interface IC (Q3) on Interface Board. If waveforms are present, check waveform at pin 13 of Module HIC on Driver Board. If waveform is missing, check Module HIC. If waveform is present, check Switch Transistor (TR2), Diodes D6 thru D17 and Driver Transistor Array (Q1). Check Carriage Motor (M2) windings for continuity, and check Connector CN7 for good connections.

LINE FEED MOTOR

Line Feed Motor (M1) does not work. Check Fuse F2. If Fuse is open, check Switch Transistors (TR1 and TR2), Diode D1 and Driver Transistor Array (Q1) for possible shorts. If Fuse is good, check Connector CN3 for good connections. If Connector is good, check for 14.4V at pin 1 of Connector CN9 on Driver Board. If 14.4V is missing, refer to the "Power Supply" section of this Troubleshooting guide. If 14.4V is present, check for waveform shown in Figure A at pins B8, B9, B10 and A9 of Connector CN3 during Form Feed. If waveform is missing, check pins B8, B9, B10 and A9 of Connector CN3 for good connections and check Interface IC (Q3) on Interface Board. If waveform is present, check for 3.0V at pin

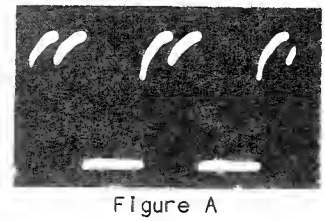


Figure A

12 of Module HIC during Form Feed. If voltage is not correct, check IC Q3 on Interface Board. If voltage is correct, check for 12.7V at base of Transistor TR1 during Form Feed. If voltage is not correct, check Module HIC. If voltage is correct, check Transistor TR1, Diodes D1 thru D5, Transistor Array Q1 and check Line Feed Motor (M1) windings for continuity.

RIBBON END SWITCH AND PAPER END SENSOR

Check voltage at pin 1 of Connector CN5. The voltage should be 5.0V with paper in Printer and Ribbon End Switch not activated. The voltage should drop to 0V if there is no paper in Printer or Ribbon End Switch is activated. If readings are not correct, check pins 1 thru 5 of Connector CN5 for good connections, check Resistor R12 and check Switch or Sensor that is not operating properly.

HOME POSITION SENSOR

Check voltage at pin 8 of Connector CN5. The voltage should be 4.5V when Print Head in Home position and 0V when head not in home position. If readings are not correct, check Resistors R13 and R14, Home Position Sensor (M5), and check pins 6, 7 and 8 of Connector CN5 for good connections.

COLOR RIBBON SENSOR

Check voltage at pin 11 of Connector CN5. The voltage should be 4.4V with a piece of black paper inserted in Sensor notch and .1V with no paper in notch. If readings are not correct, check Resistors R15 and R16, Color Sensor (M6)

and check pins 9 thru 12 of Connector CN5 for good connections. If all the sensors check good and a problem still exists, check pins A13, A14 and B14 of Connector CN3 on Driver Board and Connector CN1 and IC Q3 on Interface Board.

PRINTER WILL NOT RECEIVE DATA (SELF-TEST WORKS)

Use a logic pulser and logic probe to check operation of IC Q5 and Receive Data Amplifier Transistor (TR2). Use pulser to inject pulses at input pins 2, 4, 9 or 12 of IC Q5, and check the corresponding output pins 3, 6, 8 or 11 for pulses. To check Transistor TR2, inject pulses at pin 3 of Connector CN2 and check for pulses at collector of TR2. If pulses are not appearing at outputs of IC Q5, check for -9.2V at pin 1 and 9.2V at pin 14 of IC Q5. If either voltage is missing, refer to the "Power Supply" section of this Troubleshooting guide. If voltage is good, substitute IC Q5. If pulses are not appearing at collector of Transistor TR2, check Capacitor C4, Diode D7, Transistor TR2 and Resistors R2 and R9. If IC Q5 and Transistor TR2 check good, check CPU IC (Q6) and Interface IC (Q4).

LINE DEFINITIONS

A0 THRU A15 ..... Address Bits 0 Thru 15
ACK ..... Acknowledge, Input Data Received
ALE ..... Address Latch Enable
BUSY ..... Busy, Off Line, Data Entry, Paper Feed, Printing
CE ..... Chip Enable, ROM Memory
COLOR ..... Color Sensor
D0 THRU D7 ..... Data Bits 0 Thru 7
DATA LATCH ..... Data Latch
DTR ..... Data Terminal Ready
DW2 THRU DW5 ..... Darkness Level Lines 2 Thru 5
FAULT ..... Error State
HEAD DRV ..... Print Head Driving Pulses
HOLD MG DRV ..... Hold Print Head, Vertical Positioning
HP ..... Home Position Sensor
I-PRIME ..... Input Prime, Brings Control To Initial State, Resets System
LF DRV ..... Line Feed Motor Driving Pulses
LMP DRV ..... Lamp Drive, Ready
MDL ..... Paper End/Ribbon End Sensors
OPSW ..... Select Switch Status
PE ..... Paper Empty Sensor
PM PH1 THRU PM PH4 ..... Carriage Motor/Line Feed Motor Driving Pulses
RD ..... Read, Memory Or I/O Device
RS/CENTRO ..... Reset
RST ..... Reset Signal To Interface Circuit
RTS ..... Request To Send
SELECT ..... Select Line Indicates On Line Status
SHIFT CLOCK ..... Print Head Timing Pulses
SHIFT DATA ..... Print Head Printing Pulses
SP DRV ..... Carriage Motor Driving Pulses
SP HOLD ..... Carriage Motor Hold
SPO DRV ..... Carriage Motor Drive Control
SSD ..... Send Data From Printer
STB ..... Strobe
THALM ..... Power Level Status
TXD ..... Transmitted Data
WR ..... Write, Data Bus Info Stored In Memory Or I/O

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFGR. PART No./ TYPE No.	NTE PART No.	ECG PART No.	RCA PART No.	ZENITH PART No.	NOTES
DRIVER BOARD						
D1 THRU D17		NTE116	ECG116	SK3311	212-76-02	
D18	39B2	NTE5068A	ECG5068A	SK39V/5086A	103-270	
D19		NTE552	ECG552	SK5002	103-287	
D20		NTE116	ECG116	SK3311	212-76-02	
D22		NTE116	ECG116	SK3311	212-76-02	
HIC	MLE-7541					
Q1	STA403A					
TR1,2	B885(JAPAN)					
TR3	D768(JAPAN)					
INTERFACE BOARD						
D1,2		NTE139A	ECG139A	SK9V1/139A	103-272	
D7		NTE519	ECG519	SK3100/519	103-131	
Q1	D27128					
Q2	D4168C					
Q3	M60307					
Q4	M60306					
Q5	MC1488	NTE75188	ECG75188	SK5188/75188	HE-443-794	
Q6	M8051-178					
TR1	A952L(JAPAN)	NTE290A	ECG290A	SK3114A/290A	121-Z9003*	
TR2,3	C458B(JAPAN)	NTE85	ECG85	SK3124A/289A	121-Z9045*	
POWER SUPPLY						
A	7805	NTE960	ECG960	SK3591/960	221-Z9043	
D1	DF64D	NTE125	ECG125	SK3032A	212-Z9000	
D2		NTE519	ECG519	SK3100/519	103-131	
D3		NTE519	ECG519	SK3100/519	103-131	
PC	T.4HP521					
Q1	C3310(JAPAN)	NTE379	ECG379	SK9085/379	121-Z9111	

* Lead configuration may vary from original.

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFGR. PART No./ TYPE No.	NTE PART No.	ECG PART No.	RCA PART No.	ZENITH PART No.	NOTES
Q2	D571K(JAPAN)	NTE315	ECG315	SK3250/315	921-1010	
Q3	C945P(JAPAN)	NTE85	ECG85	SK3124A/289A	121-972	
SI1	TG4.C	NTE5332	ECG5332	SK9231		
SI2	IR30DF	NTE156	ECG156	SK3051/156	212-Z9000	
SI3	S2K49	NTE156	ECG156	SK3051/156	212-Z9000	
SI4		NTE519	ECG519	SK3100/519	103-131	
ZD	6.2B2	NTE5013A	ECG5013A	SK6A2/5013A	103-Z9008	

WIRING DATA

Shielded Hook-up Wire	Use BELDEN No.	8401 or 8421 (Single-Conductor) 8208 (Two-Conductor)
General-use Unshielded Hook-up Wire	Use BELDEN No.	8529 (Solid) Available in 13 Colors 8522 (Stranded) Available in 13 Colors

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

ELECTROLYTIC CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C4	220 200V 180 200V	
C5	100 200V 120 200V 150 200V	
C8	1 50V .47 50V	

ITEM No.	RATING	MFGR. PART No.
C11	1000 25V 100 10V 330 25V	
C12	1000 25V 4.7 50V 10 50V	
C13	100 10V 47 35V 220 16V	
C14	330 25V 100 25V	
C15	47 10V	
C16	47 35V 100 25V	

CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C1	.22 250VAC 20% .1 125VAC .1 250VAC	
C2	.0047 250VAC .1 250VAC .0047 630VAC 700 125VAC	
C3	.0047 250VAC .1 250VAC .0047 630VAC .0047 125VAC	
C4	.047 250VAC 20% .0047 125VAC	
C5	.001 1KV 470 1KV	

ITEM No.	RATING	MFGR. PART No.
C6	.047 50V .001 1KV	
C7	.1 50V 10% .001 100V .047 100V	
C8	470 1KV 10% .01 100V .1 100V	
C9	.1 10%	
C10	.001 10% .001-.047 10%	

COILS & TRANSFORMERS

ITEM No.	FUNCTION	MFGR. PART No.	OTHER IDENTIFICATION	NOTES
	POWER SUPPLY			
L1	AC Input			
L2	RF Choke			
TR	Power Transformer			
	INTERFACE BOARD			
L1	RF Choke			

CONTROLS (All wattages 1/2 watt, or less, unless listed)

ITEM NO.	FUNCTION	RESISTANCE	MFGR. PART NO.	NOTES
	POWER SUPPLY			
VR	Voltage Adjust Control	10K		

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFGR. PART No.	NTE PART No.	WORKMAN PART No.
	DRIVER BOARD			
R8	390 1% 1/4W Carbon Film			
R9	390 1% 1/4W Carbon Film			
THM1	NTC 5500 Cold			FR1007
	INTERFACE BOARD			
RM1	Resistor Network	(1)		
	Resistor Network	(2)		
RM2	Resistor Network	(3)		
RM3	Resistor Network	(4)		
RM4	Resistor Network	(5)		
	Resistor Network	(4)		
	POWER SUPPLY			
R1	5.1 5% 3W WW			
	5.6 5% 5W WW		5W5D1	
	5.1 5% 5W WW		QW415	22-1148
R2	150K 5% 1/4W Carbon Film		2W251	
	5100 5% 2W Metal Film			
R3	47K 5% 3W WW		QW222	22-1104
R4	2200 5% 1/4W Carbon Film		2W051	
	51 5% 2W Metal Film		2W110	22-4072
	100 5% 2W Carbon Film		2W382	22-4142
	82K 5% 2W Metal Film		QW210	22-1096
R5	1000 5% 1/4W Carbon Film		QW051	
	51 5% 1/4W Carbon Film			WS.68
R6	.68 10% 2W WW			
	510-2000 5% 1/4W Carbon Film		2W110	22-4072
R7	100 5% 2W Metal Film		2W5D1	
	5.1 5% 2W Metal Film		2W010	22-4048
	10 5% 2W Metal Film			
	1000-10K 5% 1/4W Carbon Film		2W047	22-4064
R8	47 5% 2W Metal Film		3W1D0	
	1 5% 3W Metal Film			
	.47 5% 3W Metal Film			
	30-300 5% 1/2W Carbon Film			
R9	10 5% 1/4W Carbon Film		QW010	22-1048
	250 5% 1/4W Carbon Film			
	150 5% 1/4W Carbon Film		QW115	22-1076
	1000 5% 1/4W Carbon Film		QW210	22-1096
	240 5% 1/4W Carbon Film		QW124	
R10	2200 5% 1/4W Carbon Film		QW222	22-1104
	10 5% 1/4W Carbon Film		QW010	22-1048
	39 5% 1/4W Carbon Film		QW039	22-1062
	51 5% 1/4W Carbon Film		QW051	
	100 5% 1/4W Carbon Film		QW110	22-1072
R11	1000 5% 1/4W Carbon Film		QW210	22-1096
	510 5% 1/4W Carbon Film		QW151	
	15K to 20K 5% 1/4W Carbon Film			
R12	22K 5% 1/4W Carbon Film		QW322	22-1128
	3000 5% 1/4W Carbon Film		QW230	
	2700 5% 1/4W Carbon Film		QW227	22-1106
	3300 5% 1/4W Carbon Film		QW233	22-1108
	0-5600 5% 1/4W Carbon Film			
R13	15K 5% 1/4W Carbon Film		QW315	22-1124
	20K 5% 1/4W Carbon Film		QW320	
	3900-10K 5% 1/4W Carbon Film			
R14	100 5% 2W Metal Film		2W110	22-4072
	15K-20K 5% 1/4W Carbon Film			
R15	150 5% 2W Metal Film		2W115	22-4076
	910 5% 1/4W Carbon Film		QW191	
	100K-220K 5% 1/4W Carbon Film			

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

FUSE DEVICES

ITEM NO.	DESCRIPTION	MFGR. PART NO.		NOTES
		DEVICE	HOLDER	
	DRIVER BOARD			
F1	1 Amp @ 250VAC Fast Acting			
F2	1.25 Amp @ 125VAC Fast Acting			
	POWER SUPPLY			
F	2 Amp @ 125VAC Fast Acting			

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
	CHASSIS		
M1	Motor		Line Feed
M2	Motor		Carriage
M3	Solenoid		Head Hold
M4	Sensor		Paper End
M5	Sensor		Home Position
M6	Sensor		Color Ribbon
M7	Print Head		
SW3	Switch		Ribbon End Sensor
	CONTROL PANEL		
SW1	Switch		Select
SW2	Switch		Darkness
	INTERFACE BOARD		
SW1	Switch		DIP
SW2	Switch		DIP
X1	Crystal		11.059 MHz
	POWER SUPPLY		
SW	Switch		Power

LOGIC CHART

INTERFACE BOARD

PIN NO.	IC Q1	PIN NO.	IC Q1	PIN NO.	IC Q2	PIN NO.	IC Q2	PIN NO.	IC Q3	PIN NO.	IC Q3	PIN NO.	IC Q3
1	H	21	P	1	P	21	P	1	L	21	H	41	H
2	P	22	P	2	P	22	P	2	L	22	L	42	L
3	P	23	P	3	P	23	P	3	H	23	L(1)	43	L
4	P	24	P	4	P	24	P	4	P	24	H	44	H
5	P	25	P	5	P	25	P	5	P	25	H		
6	P	26	P	6	P	26	P	6	P	26	H(2)		
7	P	27	H	7	P	27	P	7	P	27	H(2)		
8	P	28	H	8	P	28	H	8	P	28	H(2)		
9	P			9	P			9	P	29	P(3)		
10	P			10	P			10	P	30	P(5)		
11	P			11	P			11	P	31	P(5)		
12	P			12	P			12	P	32	P(5)		
13	P			13	P			13	P	33	P(4)		
14	L			14	L			14	P	34	L(6)		
15	P			15	P			15	L	35	P(3)		
16	P			16	P			16	P	36	L		
17	P			17	P			17	H	37	H		
18	P			18	P			18	P	38	L		
19	P			19	P			19	L	39	H		
20	L			20	P			20	*	40	H		

PIN NO.	IC Q4	PIN NO.	IC Q4	PIN NO.	IC Q4	PIN NO.	IC Q5	PIN NO.	IC Q6	PIN NO.	IC Q6
1	H	21	P	41	H	1	L	1	H	21	P
2	L	22	P	42	P	2	H	2	H	22	P
3	L	23	P	43	P	3	L	3	H	23	P
4	H	24	P	44	L	4	H	4	H	24	P
5	H	25	P			5	H	5	H	25	P
6	L	26	P			6	L	6	H	26	P
7	H	27	P			7	L	7	H	27	P
8	H	28	P			8	L	8	H	28	P
9	L	29	P			9	H	9	L	29	P
10	L	30	P			10	H	10	H	30	P
11	L	31	P			11	H	11	H	31	L
12	L	32	P			12	L	12	H	32	P
13	H	33	P			13	H	13	P	33	P
14	P	34	P			14	H	14	H	34	P
15	P	25	P					15	H	35	P
16	P	36	P					16	P	36	P
17	H	37	P					17	P	37	P
18	L	38	L					18	P	38	P
19	P	39	H					19	P	39	P
20	P	40	P					20	L	40	H

GENERAL OPERATING INSTRUCTIONS

SELF-TEST

Self-Test continuously prints the character set. To start test, hold Select button down while turning Printer On. Continue to hold Select button for two seconds, then release it. To stop test, press Select button.

NOTE: Do not use a colored ribbon when running Self-Test.

DARKNESS BUTTON

Slide Darkness button to left to print lighter, to right to print darker.

SELECT BUTTON

Press Select button once to pause, ready LED will start blinking. To Form Feed, pause Printer, press and hold Select button for two seconds.

SWITCH SETTINGS

Serial Interface Board Switches

SWITCH SW1	ON	OFF
300 Baud		1,2
1200 Baud	1	2
4800 Baud	2	1
9600 Baud	1,2	
7 Bit with parity	3,4	
8 Bit with parity	3	4
8 Bit without parity		3,4
Even parity	5	
Odd parity		5
X-ON/X-OFF Protocol		6
Ready/Busy Protocol	6	
Space at printer ready (Ready=High, +)	5	
Mark at printer ready (Ready=Low, -)		5

SWITCH SW2	ON	OFF
Spanish Characters	1	
ASCII Characters		1
17.1 CPI (Characters per inch)	2	
10 CPI		2
Auto LF (linefeed) On	3	
Auto LF Off		3
IBM Character Set #1		4
IBM Character Set #2	4	
Draft Quality	6	
Correspondence Quality		6

MISCELLANEOUS ADJUSTMENTS

POWER SUPPLY VOLTAGE ADJUSTMENT

Connect input of a DC voltmeter to pin 1 of Connector CN9 on Driver Board. Adjust Voltage Adjust Control (VR) for 14.4V.

PRINT HEAD CLEARANCE

Remove cabinet top. Loosen Phillips screw holding Head Hold Solenoid to Printer chassis. Move Solenoid to align metal slide-bar index marker with index marker on plastic end piece.

NOTE: Head Hold Solenoid is not activated while making this adjustment.

Clearance between ribbon guide and platen and between ribbon guide and ribbon stop rubber should be .02 to .04 inch (5 to 1mm). Tighten Solenoid mounting screw.

BELT TENSION

Remove cabinet top. Loosen two screws holding Carriage Motor. Measure tension of belt by hooking a tension guage in hole located on left front of the Carriage Motor. Pull guage until a tension of .66 ± .066 pounds (300 ± 30 grams) is reached and tighten Motor mount screws.

SCHEMATIC NOTES

⏚ Chassis
—✕— Circuitry not used in some versions
--- Circuitry used in some versions
⊖ See parts list
⏚ Ground

Voltages measured with digital meter.

Waveforms and voltages are taken from ground, unless noted otherwise.

Voltages, waveforms and logic readings taken with Printer running in Self-Test mode.

Waveforms taken with triggered scope and Sweep/Time Switch in Calibrate position, scope input set for DC coupling on "0" reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7.5cm width with DC reference voltage given at the bottom line of each waveform.

Item numbers in rectangles appear in the alignment/adjustment instructions.

Supply voltage maintained as shown at input.

Controls adjusted for normal operation.

Terminal identification may not be found on unit.

Capacitors are 50 volts or less, 5% unless noted.

Electrolytic capacitors are 50 volts or less, 20% unless noted.

Resistors are 1/2W or less, 5% unless noted.

Value in () used in some versions.

Measurements taken with switching as follows, unless noted:

SW2 Darkness set to Maximum Darkness
DIP Switch SW1: 1, 2, 5, ON
3, 4, 6 OFF
DIP Switch SW2: All Off

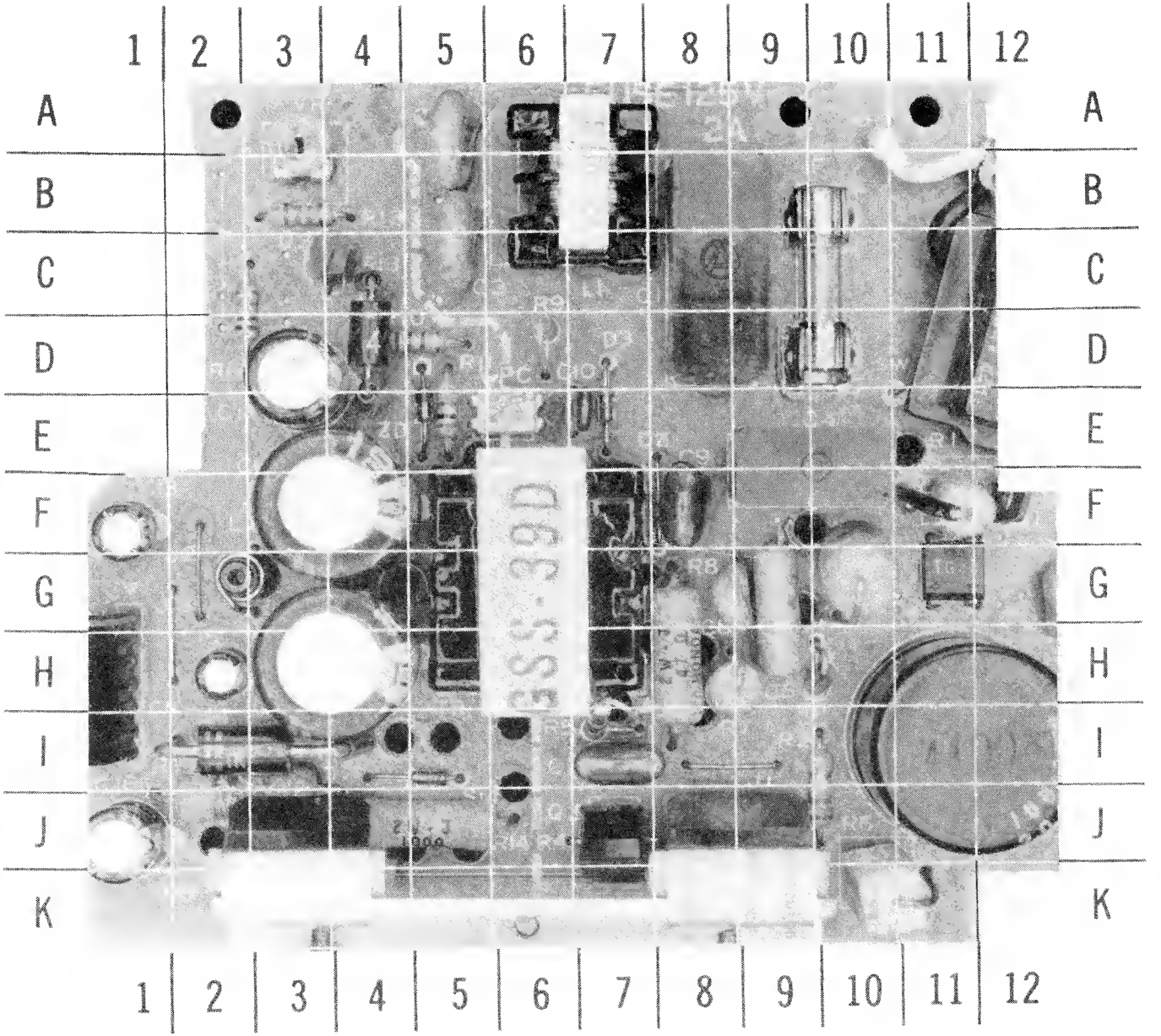
Logic Probe Display
L=Low
H=High
P=Pulse
*=Open (No lights On)

(1) Probe indicates High when Print Head is at Home position.
(2) Probe indicates High when Print Head is not printing.
(2) Probe indicates Low when Print Head is at Home position.
(4) Probe indicates Low when Print Head is not printing.
(5) Probe indicates Low when Print Head is not moving.
(6) Probe indicates pulse while Print Head is returning to Home position.

POWER SUPPLY BOARD

A Howard W. Sams GRIDTRACE™ Photo

GridTrace LOCATION GUIDE



A	K-3
C1	C-8
C2	A-5
C3	B-5
C4	E-9
C5	I-11
C6	G-9
C7	I-7
C8	G-8
C9	F-8
C10	E-7
C11	H-4
C12	F-4
C13	F-1
C14	D-3
C15	H-2
C16	J-1
C19	G-12
D1	H-10
D3	E-7
F1	C-10
L1	B-7
L2	G-2
PC	E-6
Q2	J-7
Q3	C-4
R1	F-11
R2	J-10
R3	G-10
R4	J-7
R5	I-7
R6	K-10
R7	H-9
R8	H-8
R9	D-6
R10	D-5
R11	E-5
R12	C-3
R13	B-3
R14	J-5
R15	J-2
S11	G-11
S12	I-2
S13	D-4
S14	I-5
TR	G-6
VR	A-3
ZD	E-5

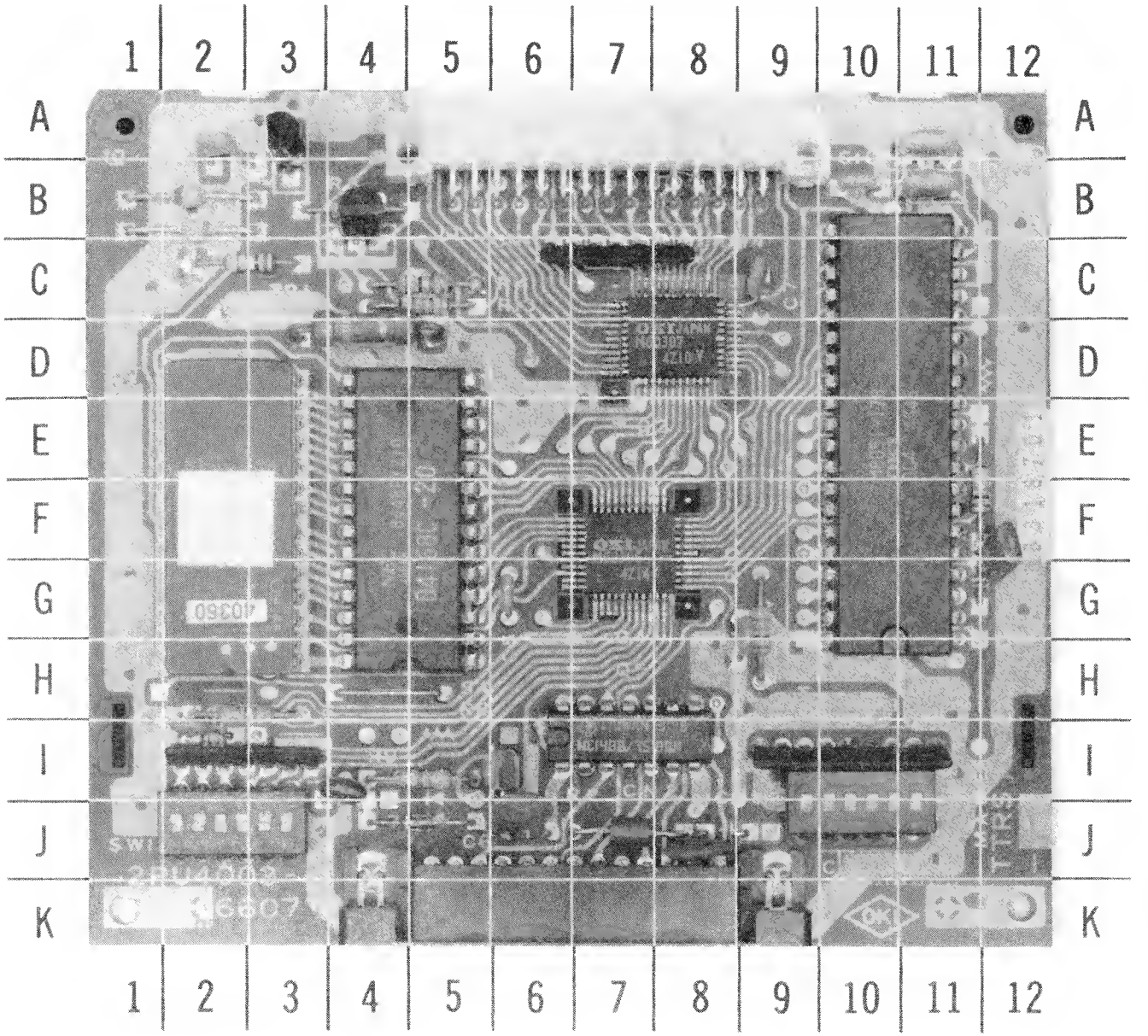
OKIDATA
MODEL EN3211 OKIMATE 20

NOTE: ARROWS ON IC'S INDICATE PIN 1 UNLESS NOTED

A Howard W. Sams CIRCUITRACE® Photo

POWER SUPPLY BOARD

A Howard W. Sams GRIDTRACE™ Photo

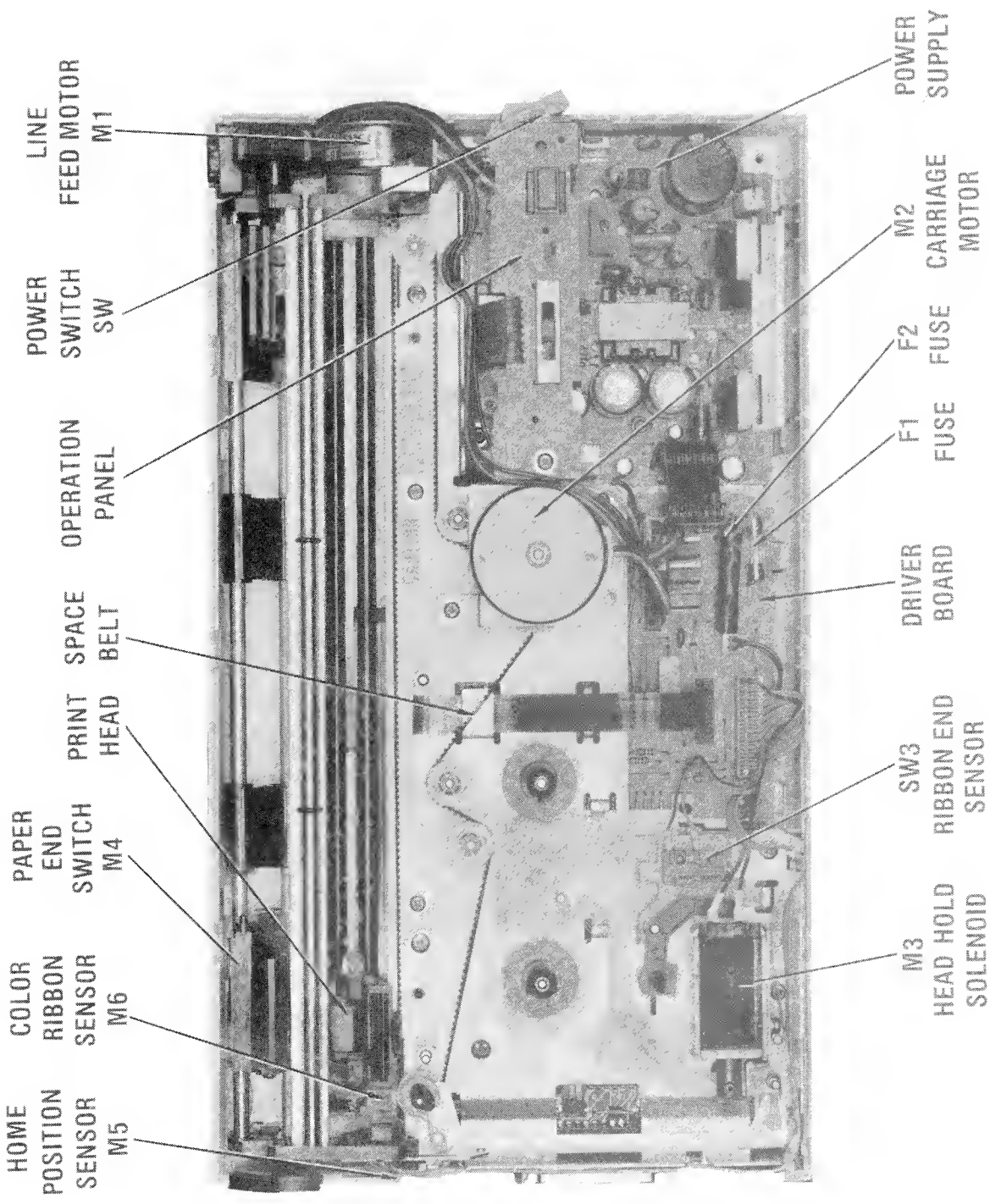


GridTrace LOCATION GUIDE

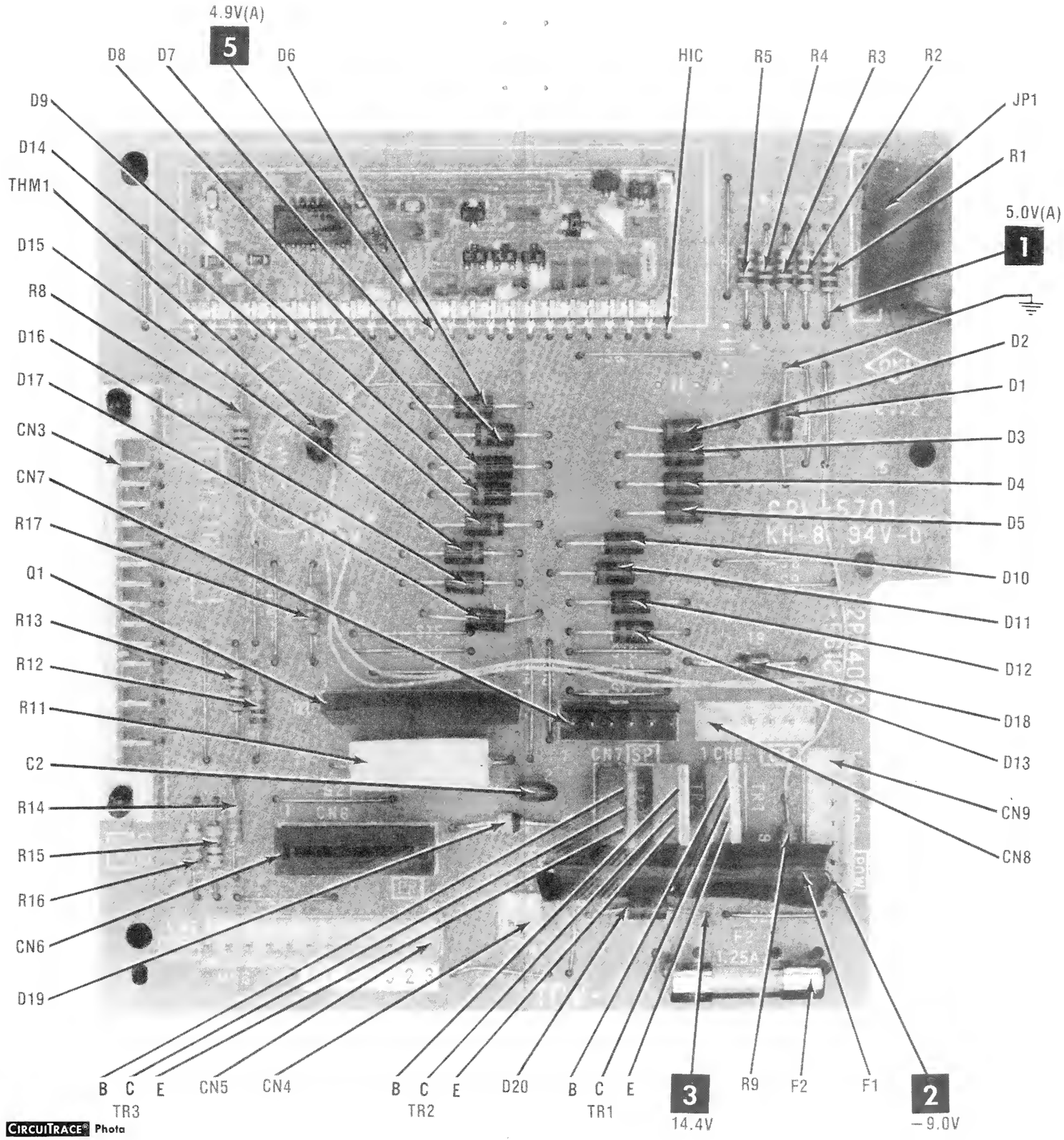
C1	A-2
C3	I-2
C4	I-4
C5	G-6
C6	J-6
C7	C-9
C8	G-9
C9	J-8
C10	B-10
C11	F-12
C12	A-11
CN1	A-7
CN2	K-7
D1	B-2
D2	B-2
D7	J-5
L1	J-7
OSC	B-11
Q1	F-2
Q2	F-4
Q3	D-8
Q4	F-7
Q5	I-7
Q6	D-10
R1	D-4
R2	H-2
R3	B-4
R4	F-7
R5	I-7
R6	D-10
RM1	I-2
RM3	I-10
RM4	C-7
SW1	J-2
SW2	J-10
TR1	B-4
TR2	I-6
TR3	A-3

A Howard W. Sams CIRCUITRACE® Photo

INTERFACE BOARD



CHASSIS-OVERALL VIEW



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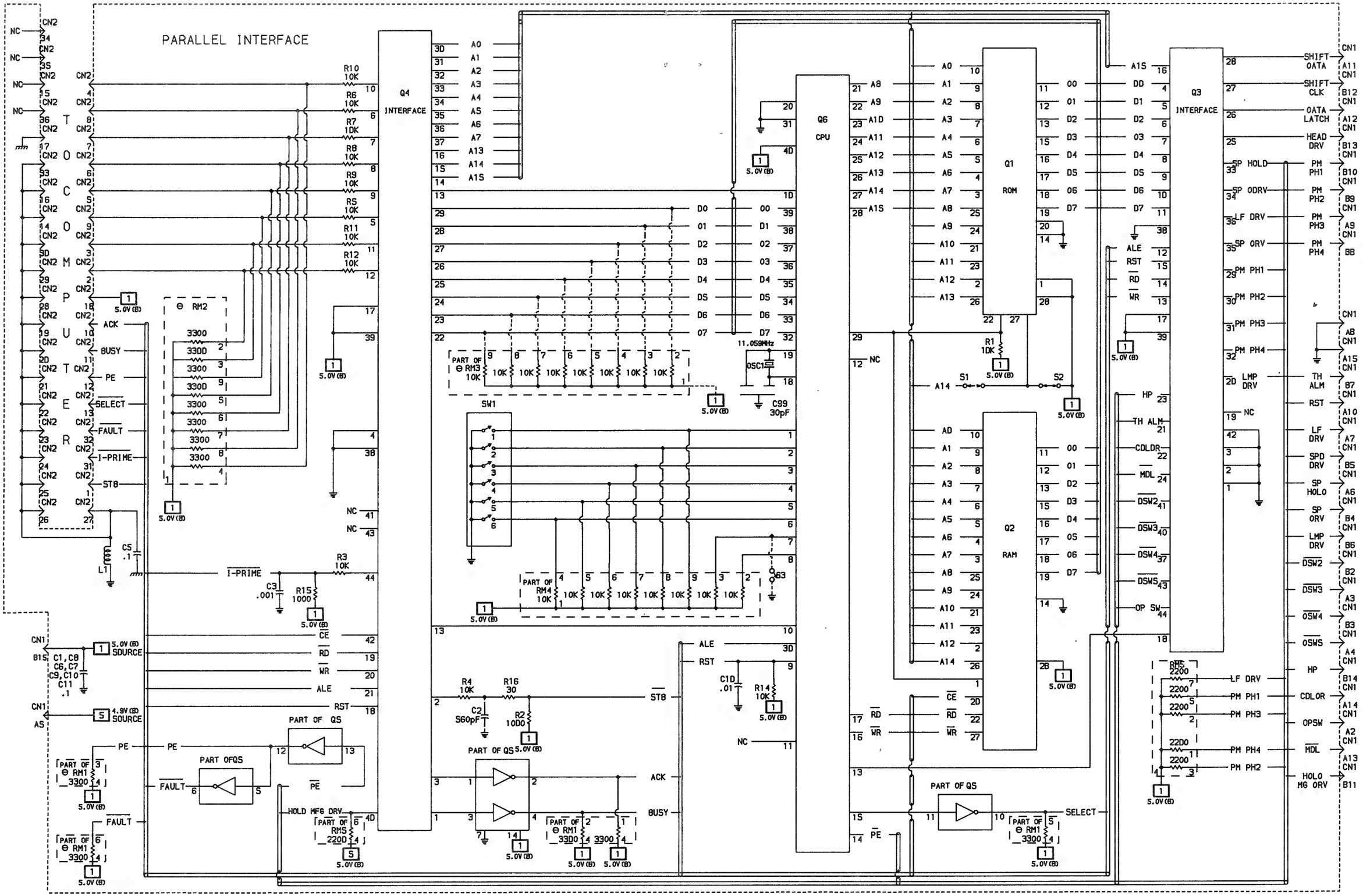

A PHOTOFACT STANDARD NOTATION SCHEMATIC

WITH CIRCUITRACE

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DISASSEMBLY INSTRUCTIONS

CABINET REMOVAL

Remove ribbon cartridge and carriage assembly cover. Remove two screws located in front of Carriage assembly holding cabinet top to chassis. Push cabinet top toward rear to release tabs on inside rear edge and lift up rear. When rear edge is clear of chassis, move top forward to clear front tabs and lift top from Printer.

PRINTER MECHANISM REMOVAL

Remove Control Panel cover. Disconnect Connectors CN4 thru CN8.

NOTE: Lift up cap on Connector CN6 before pulling flat ribbon cable out.

Remove three screws holding mechanism to cabinet bottom.

POWER SUPPLY AND DRIVER BOARD REMOVAL

Remove cabinet top and Printer mechanism. Remove two screws holding Power Supply Board to cabinet bottom. Push back tabs holding front of Driver Board and lift Driver and Power Supply Boards from cabinet.

CARRIAGE MOTOR ASSEMBLY REMOVAL

Remove cabinet top. Disconnect Connector CN6 from Driver Board. Remove two screws holding motor assembly and remove assembly.

PAPER FEED MOTOR REMOVAL

Remove Printer mechanism. Disconnect Connector CN8 from Driver Board. Remove two screws holding Paper Feed Motor and remove Motor.

BELT REMOVAL

Remove cabinet top and Control Panel cover. Remove Carriage Motor assembly. Remove two springs from metal linkage going from Head Hold Solenoid to left belt gear (one spring at each end of the link). Insert a flat-blade screwdriver between left belt gear and metal link. Pry link and ribbon stop lever off gear post, note position of ribbon stop lever for reassembly. Remove belt from Print Head assembly and gear pulleys.

RIBBON REMOVAL

Turn Power Off. Lift ribbon access cover. Pull back on Print Head assembly until it snaps back. Lift used ribbon cartridge out. Place new cartridge into compartment, rear end first. While lowering front end, make sure ribbon is in front of Print Head and behind ribbon guides. Snap head back into printing position.

REPLACING PRINT HEAD

Remove ribbon cartridge. Pull back on Print Head Lock Lever, directly behind Print Head. Lift Print Head straight up out of holder.

BLOCK DIAGRAM

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.

2. Maintain AC line voltage at rated input.

3. Remove AC power from the Computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.

4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.

5. Use a grounded-tip, low voltage soldering iron.

6. Use an isolation (times 10) probe on scope.

7. Do not remove or install Boards, Floppy Disk Drives, printers, or other peripherals with Computer AC power On.

8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.

9. This Computer is equipped with a grounded three-pronged AC plug. This plug must fit into a grounded AC power outlet. Do not defeat the AC plug safety feature.

10. Periodically examine the AC power cord for damaged or cracked insulation.

11. The Computer cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.

12. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.

13. Never expose the Computer to water. If exposed to water turn the unit Off. Do not place the computer near possible water sources.

14. Never leave the Computer unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.

15. Do not allow anything to rest on AC power cord.

16. Unplug AC power cord from outlet before cleaning Computer.

17. Never use liquids or aerosols directly on the Computer cabinet. Spray on cloth and then apply to the Computer cabinet. Make sure the Computer is disconnected from the AC power line.

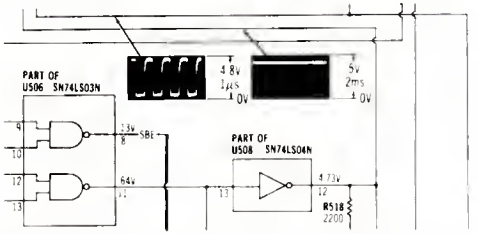
HOWARD W. SAMS & COMPANY

Remove staples and use cover for file folder.

COMPUTERFACTS™ put easy to use, informative technical data right at your fingertips. Each edition includes specific service information on the individual component, along with some overall troubleshooting hints.

The following information is just a sample of the many valuable time saving features contained in this exclusive Sams COMPUTERFACTS publication:

- Preliminary Service Checks section is an easy to use, step by step guide for the experienced technician or hobbyist, and even beginners.
- SAMS famous industry accepted standardized notation schematics containing CIRCUITRACE® , GRIDTRACE™, waveforms, voltages and stage identification.

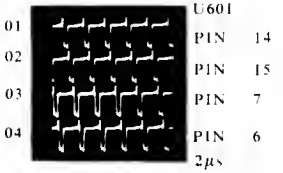


- Step by Step Troubleshooting guides the technician through the necessary procedures to quickly locate the problem.

TROUBLESHOOTING

MICROPROCESSOR CHIP (CPU) OPERATION

Verify the processor is functioning by checking the signals on the address lines (pins 10 thru 24 of IC U600) and the data lines (pins 41 thru 56) using a logic probe or a scope if a logic probe is used, refer to the "Logic Chart" for the correct readings. If a scope is used, the waveforms on the address lines (except pins 22 and 23 which have no signal in Power Up mode) should be similar to Figure 1. The waveforms on the data lines should be similar to Figure 2.

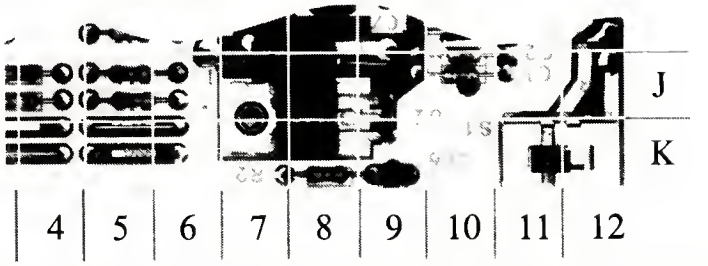


- Logic Chart containing logic probe readings to isolate defective circuitry and components.

LOGIC

PIN NO	IC U100	PIN NO	IC U100	PIN NO	IC U102	IC U103	IC U104	IC U105	IC U106	IC U107	IC U108	IC U109
1	P	21	P	1	P	P	P	P	P	P	P	P
2	P	22	P	2	P	P	P	P	P	P	P	P
3	P	23	P	3	P	P	P	P	P	P	P	P

- Quick Component Location using the SAMS exclusive GRIDTRACE, CIRCUITRACE, and component photographs.



- Complete Components Parts List in an easy to use format with field replacements shown when possible. SAMS unique semiconductor, chip and IC cross-reference gives you many replacements to choose from and is available at your Electronic Distributor.

SEMICONDUCTORS (Select replacement for best results)

			REPLACEMENT DATA				
ITEM No.	TYPE No.	MFGR. Part No.	ECG Part No.	NTE Part No.	RCA Part No.	ZENITH Part No.	NOTES
D102	1SS53	1149-2576	ECG519	NTE519	SK9091-177	103-131	
D103	2N60EM	1149-2527	ECG109	NTE109	SK3088	103-Z9001	
D201	1N4004GP	1201-4205	ECG116	NTE116	SK3312	212-76-02	
D501 thru D503	1SS53	1149-2576	ECG519	NTE519	SK9091-177	103-131	

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